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THE
ASIATIC SOCIETY OF BOMBAY
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IMPERIAL INSTITUTE SERIES.

(1)

GUIDES

TO

OMMERCIAL COLLECTIONS.

INDIAN SECTION.

No. I.

GUIDE TO COLLECTIONS OF 1892.

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PREFACE.

The Government of India have arranged to provide to the Imperial Institute for the illustration of the Economic Products of India—

(A) a descriptive Catalogue or Dictionary;

(B) an index collection of all products;

(C) a commercial collection of special products;

(D) a hand-book descriptive of C.

A.—The descriptive Catalogue has been completed, and is termed the "Dictionary of the Economic Products of India." The compilation has occupied eight years, and has been made under the Editorship of Dr. G. Watt, C.I.E., Reporter on Economic Products to the Government of India. It has been confined to the collation of facts and statistics available up to the date of the publication of the work.

To each product there is assigned in the Dictionary a separate number, which will be permanently maintained for purposes of reference.

B.—The index collection will, when completed, be comprised of small samples of every economic product of India, which will bear the same numbers as those assigned to the products in the Dictionary.

C.—The commercial collections are on a larger scale. The number of products of which a collection is provided each year will be limited to about twenty.

Each collection will comprise as complete a set of specimens of the product in its raw and manufactured state as is necessary for the fulfilment of the object with which the commercial collections and hand-books are provided.

D.—The hand-books will supply, in a separate pamphlet for each product, the information contained in the Dictionary, amplified by supplementary facts and statistics and illustrated by maps, diagrams, photographs, etc.

The objects of the commercial collections and hand-books which accompany them are:—

1. To secure, while each collection is being made for the Institute, a thorough and special investigation in India through which fresh information regarding the product concerned, not contained in the Dictionary, may be obtained.
2. To illustrate the Dictionary in a manner more complete than can be effected by the index collection.
3. In the case of products which are not generally known—
   (*a*) to bring them to the notice of those interested;
   (*b*) to indicate the extent to which and conditions under which they are procurable;
   (*c*) to ascertain their commercial value;
   (*d*) to secure, through the Governing Body of the Institute and commercial experts whom they may consult, such special trial or analysis of them as can be more effectually made in England than in India.

E. C. BUCK,

Secy. to the Govt. of India,
Dept. of Revenue and Agriculture.

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IMPERIAL INSTITUTE SERIES.

IDES TO COMMERCIAL COLLECTIONS.

INDIAN SECTION.

No. 1 Guide to Collections of 1892.

DHATODA VASICA.
OAL.
OTTON.
UTCH.
IBRES USED FOR BRUSH-MAKING.
NDIGO.
ECACUANHA.
ON.
TE.
ICA.

MORINDA (ÁL DYE).
PADAUK TIMBER.
PODOPHYLLUM EMODI.
RESIN AND TURPENTINE FROM INDIAN PINES.
SIDA FIBRE.
SILK.
CASTOR OIL.
LINSEED.
SESAMUM (GINGELLY).

ADHATODA VASICA.

Leaves collected in a village near Calcutta, and watery extract made from leaves, were sent to the Imperial Institute with a view to securing complete knowledge, through examination by experts, of the physiological properties of a product used in India both for medical and agricultural purposes, and to bring the product to notice in Europe.

The plant is common in Bengal and Sub-Himálayan tracts, and its range is from the Panjáb and Assam to Ceylon and Singapore. The leaves are used in the treatment of pulmonary affections and for killing low forms of life (algæ, etc.) injurious to rice crops. It has been suggested that a decoction might be found useful in destroying animal pests of crops such as sugar-cane, tea, and coffee, and that the leaves might be tried as a purifier of foul water in tanks which are used for drinking purposes. An aqueous solution of an alcoholic extract of the leaves was tried upon flies, fleas, mosquitoes, centipedes, etc., and, in every case, the application was followed by poisonous results.

COAL.

BENGAL.

Bengal Coal Company.

Coal from Barakar, Deshagar (Sanktoria), Khooldeah (Kurhurbaree), Liakdi quarry (Barakar), Madhubpur, Nimcha, Ráníganj, Sanktoria, Searsole (Ráníganj), and Sodepur.

Coke manufactured from Khooldeah and Sanktoria coal.

East Indian Railway (Kurhurbaree) Colliery.

Coal from Jogiland seam, and from Kurhurbaree upper and lower seams.

Coke.

Natural coke and trap.

Trap.

Sandstone.

Fire-clay.

Shale.

Barakar Coal Company.

Coal and Coke.

CENTRAL PROVINCES.

Warora Colliery.

Coal from No. 2 and No. 3 seams.

Sandstone from No. 3 seam.

Fire-clay from No. 2 seam.

Fire-bricks.

Nerbudda Coal and Iron Company.

Mohpani coal-mines.

Coal from Nos. 1, 2, 3 and 4 seams.

Specimens from Nos. 1, 2, 3 and 4 seams, showing the junction of the seam with roof or top and thill or bottom, and from No. 4 seam showing the junction of the seam with the bottom.

CENTRAL INDIA.

Umaria Colliery.

Coal.

Iron pyrites.

Bricks made from fire-clay, burnt and sun-dried.

HYDERABAD.

Hyderabad (Deccan) Company.

Singareni.

A series of specimens of coal.

ASSAM.

Assam Railways and Trading Company.

Coal from Ledo Valley.
Coke made from Ledo Valley and Tikak coal.
Fire-clay and ochreous clay from Upper Ledo Valley.
Bricks and tiles made at Ledo Brick-works.

Cherra-punji Coal-field.

Coal and limestone.

Maoflong Coal-field.

Coal.

BALUCHISTAN.

Khost Colliery.

Coal from Khost and Killa Hakim seams.
Nummulitic limestone, which occurs in boulders on the surface.
Shale from roof of coal, showing vegetable remains.
Sandstone which alternates with shale in strata.
Middle dirt from Khost seam.

Up to 1884 coal was only worked in Bengal and the Central Provinces, whereas at the present day coal-fields have been opened up in Bengal, Assam, Central Provinces, Central India, Punjab, Baluchistan, Nizam's Dominions (Hyderabad), and Burma. The only Provinces, in fact, in which no mines have been opened are Bombay, Madras, and the North-West Provinces.

The number of collieries increased from 47 to 82 between the years 1880 and 1890, and the output increased from 997,730 tons in 1881 to 2,168,521 in 1890, more than doubling within the decade.

COTTON.*

BENGAL.

CALCUTTA.

Bowreah Cotton Mills Company.

Bengal yarn, 10s and 12s.
Bengal and Bombay mixed yarns, 16s and 20s.
Bombay yarn, 30s.

Calcutta Cotton Mills Company.

Twist Nos. 10, 12, 14, 16, and 20.

Samples of cotton (Bombay and Bengal mixed) from which the twists are made.

Dunbar Cotton Mills.

Yarn, single, 10s.
„ double, 3-16s.

Goosery Cotton Mills Company.

Yarn; counts 10s, 14s, 16s, 20s, 22s, and 24s.

BACKERGUNGE DISTRICT.

Dhuti (waist-cloth worn by males) made to order from home-spun thread.

Saris (cloths worn by females) made to order from imported thread No. 120.

Home-spun thread.

At Ujirpur there are at present about 30 weaver families, of which only four or five have kept up the weaving profession. Imported goods are so cheap that the country-manufactured saris, dhutis, etc., can scarcely compete against them. With the decline of their trade the weavers have fallen into hopelessly indolent habits.

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* The Bombay collections of cotton will be dealt with in 'Guide to Commercial Collections,' No. 2.

BALASORE DISTRICT.

Dhuti and chadar (sheet or scarf).—Generally worn by males, except Bengalis and prosperous Uriyas, who prefer imported goods.

Dasia.—Used extensively for bed covers and pads for pack bullocks.

Bathing towel (gamcha).

Pagri (turban).—Used universally by Muhammadans in Bhadrakh on the occasion of marriages.

Sari, two varieties.—Worn by females, except near towns, where imported fabrics have taken their place.

BANKURA DISTRICT.

Coarse sari.—Made from European white twist No. 12, and red twist No. 40. Worn by women of the labouring class, and highly prized on account of its durability. The cost is ₹1-0-6, and a similar sari of English manufacture can be purchased for 14 annas or less.

Duria or striped sari.—Made from European white and red twist No. 16. Commonly worn by women of the agricultural class, and prized on account of its durability ; annas 14-3.

Black-bordered sari.

BIRBHUM DISTRICT.

Alunda sari ; ₹1-3.
Hetampur sari, No. 1 ; annas 15-6.
„ „ „ 2 ; ₹1-1-6.
„ „ „ 3 ; annas 11-6.
„ „ „ 4 ; ₹1.
Ilambazar „ ₹1-4.
Mirzapur „ annas 10.
Tantipara „ annas 15-6.

These saris are manufactured at the above places from English yarn, and are worn by the poor and lower middle classes.

Bathing towel.

Dhuti ; annas 5-6.—Made from home-spun cotton. The manufacture is being superseded, the people preferring cloths of English manufacture as being better and cheaper. Coarse dhutis for the poor are made from home-spun cotton.

Napkin No. 1 ; annas 2.
„ „ 2 ; „ 3.
„ „ 3 ; „ 3-6.

These are largely used as bathing towels, and sold at the Hetampur market. Imported fabrics are also used for this purpose.

Girl's cloth (ferani) No. 1; annas 1-3.
„ „ „ „ 2; „ 1-3.
„ „ „ „ 3; „ 1-6.

Parda (certain) cloth.

Home-spun yarns and threads have practically disappeared, English yarn and imported cotton being almost exclusively used.

The spinning of Brahmanical threads, and of thread for certain kinds of coarse cloth, is confined to Brahman widows and petty weavers, mostly of the Kaora and Kumar castes and Santals.

The manufacture of piece goods has also given way to Bombay chadars and English piece goods. A class of goods called "madrasi than" used to be made, but its manufacture has been given up.

Alunda floor-cloths are manufactured in a variety of colours by the weavers of Alunda only. Their sale is extensive, and only the rich can afford to buy them. A pair of coloured cloths, 3 × 2 yards, would cost ₹15, or ₹7-8 each.

BURDWAN DISTRICT.

Twig with leaves and pods of cotton, called ram-kapash, from which the best muslins and Brahmanical threads are manufactured.

Twig with flowers and pods of cotton from which Brahmanical threads are manufactured, as well as fine thread for muslin.

Cotton grown in the Raniganj Police Circle (thana).
„ „ Assensole „ „

Coarse cloths worn by coolies.
„ „ lower classes, and used for making dusters.

Dhutis called satgachia.
„ „ shelimabad, worn by lower classes on festive occasions ₹2-2 per pair.

Dhuti, blue bordered.—Worn by Bengali youths and middle-aged men of the middle classes; ₹1-10. The industry is dying out gradually.

Dhuti with blue and green striped border.—Worn by lower classes as a holiday dress; ₹1-4. Manchester fabrics are gradually replacing these cloths.

Handkerchief of hand-loom made muslin used by native noblemen and gentlemen; not much in demand; ₹1.

Mosquito curtain cloth.—Used for making curtains by the poor and middle classes in Bengal and Bihar. Made in Burdwan; ₹2-6. Still in demand notwithstanding competition.

Napkin, coarse.—Made at Sahibganj from home-spun thread.

Napkin called memari; annas 5.

Saris, coarse.—Made from home-spun thread for the use of low classes, *e.g.*, Bauri and Santal women, etc.

Home-spun threads used for making coarse fabrics.

Fine hand-made thread used for making dhutis and saris worn by Bengalis of the upper classes.

The above fabrics are generally sold within the district and in parts of the neighbouring districts. About seven-eighths of the fabrics required for local use are supplied from Manchester. The total value of the annual outturn of all the hand-looms in the district is not more than ₹70,000.

CHITTAGONG.

Alwan (shawl).—Green and red.

Bathing towels.

Check towels.

Largely used by all castes and classes. Manufacture not much affected by imported goods.

Checks for shirting.—In imitation of British manufacture, and slowly coming into use.

Dhutis.—Worn by males of all castes. Trade nearly extinct.

Dongas of various patterns worn by Muhammadan women, Maghs, and the lowest classes of Hindus. Used in pairs, one piece as an under-garment, the other as an upper-garment. Largely used, but being replaced by imported goods.

Jháran (duster).—Largely used by all castes and classes.

Lungis of various patterns.—Worn by males as an under garment, and largely used by Muhammadans and Maghs. Being replaced by imported goods.

Sari.—Worn by women of all castes.

Saris— „ „ little girls.

The trade in saris is nearly extinct.

Wrappers of various patterns.—Largely used as winter sheets by the poorer classes of all castes. Lately introduced in imitation of British manufactures.

Yarns, home-spun.—Used by Hindu weavers only to a small extent. English yarns are mostly used by weavers of all classes.

CHITTAGONG HILL TRACTS.

Bini or khaki (brown) coloured cotton :—

Leaves and flowers.
Cotton in capsule.
„ uncleaned.
„ cleaned.

Cotton (dhaga) ready for being made into paich.
„ (paich) ready for being spun into yarn.

White cotton :—

Leaves and flowers.
Cotton in capsule.
„ cleaned.
„ ginned.
„ (dhaga) ready for being made into paich.
„ (paich) ready for being spun into yarn.

Home-spun yarn.
Petticoat worn by Magh females; ₹1.
Breast cloth „ „ „ ; made with home-spun thread; annas 8.
Head-dress „ „ „ ₹1-6.
Shawl worn by Banjagi males; ₹3.
Dhuti „ „ „ ₹1.
Petticoat „ „ females; annas 8.
Head-dress worn by Banjagi Lushais; ₹1.

Petticoat worn by Tongchongya females. Made by them with home-spun thread; ₹2.

Breast cloth worn by Tongchongya females. Made by them with home-spun thread; ₹2.

Turban worn by Tongchongya females. Made by them with home-spun thread; ₹1.

Petticoat worn by Múrúng females; annas 8.
Waist coat „ „ „ „
Breast cloth worn by Khumi females. Made by them with home-spun thread; annas 4.

Shawl cloth worn by Khumi males; ₹1-8.

Breast cloth worn by Chakma females. Made by themselves; ₹2.
Petticoat „ „ Made by them with home-spun thread; ₹2.

Petticoat worn by Tippera females; ₹1.
„ „ Reang „ ₹1.
Breast cloth „ „ „ annas 8.
Belt used by females; annas 6.
Breast cloth; annas 8.
Dhuti; annas 13.
Head-dress, called ghamba; annas 8.
Waist cloth; annas 8.

Cotton is now manufactured in these tracts by females for home use only. There is no local trade. Foreign piece goods have, to a large extent, taken the place of local manufacture, especially of male clothing, except among the aborigines who live in outlying places.

CUTTACK DISTRICT.

1st Class.

Gulnagar sari.—Nos. 1, 2 and 3 qualities.

2nd Class.

Kishnagra sari.
Kathari „

3rd and 4th Classes.

Sari.
Khadi dhuti.
Sheet.

Owing to the importation of machine-made cloths, etc., the trade in local manufactures is declining. The trade in best Gulnagar cloths has fallen from ₹50,000 to about ₹10,000 per annum, and they are used only by the rich and middle classes, especially on the occasion of marriages and religious ceremonies. The coarsest kinds of cloth (3rd and 4th classes) are used by the agricultural and labouring classes, and preference is given to them on account of their being more durable than machine-made cloths.

The thread from which the cloths of the first two classes are woven is machine-made and imported; but the thread used for the 3rd and 4th classes is generally prepared by the people who use the cloth from cotton grown on their own fields.

Since last year the cultivation of a kind of Nankin khaki (brown) cotton has been introduced into Madhupur as an experiment.

DACCA DISTRICT.

Cotton with seed.
„ cleaned.

The raw cotton is imported from Comilla, Chittagong and Mymensingh. Practically no cotton is grown in the district.

DARJEELING DISTRICT.

Paharia cloth.—Woven by Nepalese in Nepal and Darjeeling district.
Bhutia cloth.—Woven by Bhutanese, and worn by Bhutia females.
Chadar.—Woven in Darjeeling district and Sikkim. Worn by Lepchas.

DINAJPUR DISTRICT.

Fota.—Made from home-spun thread, and worn by native women to cover their breast.

Imported goods are reported not to have to any extent interfered with the indigenous industry.

DARBHANGA DISTRICT.

Charkhana.—Cloth manufactured to a considerable extent in the Madhubani Sub-division; ₹2.

Kokti.—Cloth manufactured from home-spun yarn in the Madhubani Sub-division. It is said to be made from a special kind of cotton of a light brown colour which does not disappear by washing. The cloth is as smooth and soft as silk. It is chiefly used for the purpose of dhuti, sari and dohar, generally by Brahmans of superior class. The price varies from ₹15 to ₹25 a piece.

The indigenous manufactures are gradually declining owing to the import of cheap piece goods.

FARIDPUR DISTRICT.

Ten varieties of check cloth used by the middle and lower class for making shirts, coats, etc.; ₹2-12 to ₹1-12.

Thenti sari.—Worn by Hindu and Muhammadan married women of the lower class; annas 12 to 14.

Tabban.—Manufactured in pairs, one being worn above and the other below the waist. Red bleached tabban is worn by married Muhammadan women of the lower class; black bleached and unbleached tabban by widows only; annas 14 to ₹1 per pair.

Napkin.—Generally used by all classes of men and women: annas 3 to 4.

All the above cloths are made from English twist and yarn, home-spun thread being seldom or never used. Their consumption within the district is very limited, imported goods having almost entirely taken the place of indigenous manufactures.

GAYA DISTRICT.

Carpet (kalin).—Manufactured at Obra and Dandnagar. Coarse specimens are always available, but fine ones are made to order. The extent of the trade is estimated at ₹3,000 per annum. Not replaced by imported goods.

Carpet (dari).—Manufactured at Obra and Dandnagar. The extent of the trade is estimated as ₹4,000. Not replaced by imported goods.

Do-ál and khari.—Manufactured at Raffiganj. The trade has greatly decreased in consequence of the importation of mill-made cloths. They are doubled and made into saris for females.

Sari and dhuti.—Manufactured in every police station and out-post of the Aurangabad sub-division. They are also made into sheets

The trade is valued at ₹30,000, but has greatly dimi-
onsequence of the importation of mill-made cloths.
amcha).

HÁZARIBÁGH DISTRICT.

twigs with leaves and cotton in capsule.
separated from capsule.
thread, 1st and 2nd qualities.—Spun by lower classes of the rural tracts.
vá.—Worn by low classes of males only in the rural tracts.
tured by Jolhas ; annas 4.
ti.—Worn by males only in the rural tracts. Manufactured by annas 8.
i or kharia, 1st and 2nd qualities.—Worn by women only in ral tracts. Manufactured by Jolhas ; ₹1-6 and ₹1.
lam.—Manufactured by Jolhas. First quality worn by all classes rural population ; ₹3-7. Second quality worn by poorer classes rural population ; ₹2-4.
important towns the well-to-do classes, as a rule, wear imported , and the imported saris and dhutis have to a large extent taken ce of the local manufactures. Speaking generally, two-thirds rade in towns is carried on with imported piece goods.

HOOGHLY DISTRICT.

aukhubi pacha par sari.—	Made at	Begampur ;	₹1-5-3.
Dure „	„	„	₹1-6.
Nilámbari „	„	„	₹1-6.
Babu dhakka pacha par sari	„	Kharsarai.	₹1-9.
Basanti chaukhubi dure „	„	„	₹1-5-3.
Jara „ „ „	„	„	₹1-8.
Lal sada „ „ „	„	„	₹1-9.
Nilámbari sada dure phulpere sari.	„	„	₹1-10.
„ „ „	„	„	₹1-9.
Rangin „	„	„	₹1-4-6.
Sabuj chaukhubi dure „	„	„	₹1-9-6.
Sada „ saris	„	„	₹1-5 ; ₹1-6-6.
„ tekhati „ sari	„	„	₹1-4-3.

Begampur and Kharsarai are adjacent villages famous for their chequered saris manufactured for women and girls of all classes. The trade is very extensive, being carried on with Calcutta and many other places in Bengal. The trade has not been so much affected by imported piece-goods as that of plain cloths, as the price of the saris is not high, and they command a large sale.

Kasipar sari.—Made at Haripal; ₹2-3.

The trade in these saris is not very extensive, and they are sold in the village or neighbourhood, it being very seldom plus remains which is sent to Calcutta. The trade was fo brisk, but most of the weavers, finding that the people wore cloths, left the village.

Black-bordered dhutis.—Made at Koikala; ₹1-12 to ₹2-

The weavers of Koikala are descendants of some Chander ers, who settled there thirty or forty years ago. The trade very extensive, but is still carried on with Calcutta and Seram

Urunis or chadars—Made at Rájbalhát; annas 14 to ₹2-2

Rájbalhát is famous for its chadars, which are used by Bengali gentlemen. The trade is decreasing owing to the im of Manchester cloths, though it is still carried on with Calcu other places. The chadars are generally purchased as *Puja* prese relations.

Black-bordered dhuti.—Made at Serampore;				₹2-4.
Jubilee	„	„	„	₹1-9.
Yellow	„	„	„	₹1-14.
Black	„ sari	„	„	₹1-14.
Blue-black	„	„	„	₹1-13.

Sonaper or gold-bordered sari.—Made at Serampore ; ₹1-12.

The trade in Serampore dhutis has been nearly entirely sup by Manchester cloths.

The trade in saris is dull except at the Durga Puja season, wh are largely purchased as presents. The women generally wear M ter saris at home, and country-made saris when they go to fes to visit relations.

Kala basanti dure sari.—Made at Tajpur ; ₹1-4.

Lal chaukhubi „ „ „ „ ₹1-3-6.

Some weavers left Begampur and Kharsarai some years ago, and settled at Tajpur. There are only a few looms at work, and the trade is very small.

JALPAIGURI DISTRICT.

Cotton from Bhalka.

„ „ Falakata.

Stems with pods, from Alipur Duars.

KHULNA DISTRICT.

Dhuti, blue-bordered.—Worn by Hindu and Muhammadan men.

Saris called tabban.—Worn by lower classes of Muhammadan women.

Mosquito curtain.

These fabrics are woven by Tanti and Jolha (Hindu and Muhammadan) weavers, with yarn imported from England, which has entirely taken the place of home-spun yarn. The weavers have now almost all left their looms, and taken to other means of earning a living.

No cotton is cultivated in the district.

LOHARDAGA DISTRICT.

DALTONGANJ.

Cotton pods, 3-lobed (tin teriya), and cotton with and freed from seed.

Cotton pods, 4-lobed (char teriya), and cotton with and freed from seed.

PALAMAU SUB-DIVISION.

Cloth called dowal, variety mansinghi.

" " gohumi.

Dowal cloth is manufactured by native weavers, and chiefly used by women of the aboriginal tribes. The consumption is limited, as the price of a sari is about twice that of one made of common country cloth. During the last thirty years the consumption of dowal cloth is said to have increased by 25 per cent., the increase being due to the people becoming more fashionable.

Coarse cloth, called motia, used by poorer classes who cannot afford to buy imported cloths.

Home-spun thread which is being largely replaced by imported thread.

MALDA DISTRICT.

Dhuti and chadar made of thread Nos. 80 and 100.

The demand for these has been reduced by the importation of English fabrics, which are cheaper; but the country-made cloth has a fairly ready sale, notably during the Durga Puja and other festivals.

Towel manufactured from imported thread Nos. 40 and 60 by native weavers.

Mosquito curtain manufactured from imported thread Nos. 40 and 60 by native weavers. The price varies from annas 8 to R4-8. Sometimes exported to Calcutta.

MANBHUM DISTRICT.

Six kinds of cotton are grown in this district, *viz.*, kherwa, manga, buria, bori, lurki, and jhit boria.

I.—Kherwa.

Twig with pods.
Cotton with seed.
„ ginned.
Thread.
Dhuti.
Sari.—Worn by Santal women.

The thread is comparatively coarse. The weavers, before manufacturing cloth from it, keep the thread dipped in rice gruel for a short time, and then dry it. This process, it is believed, makes the thread strong, and the cloth more lasting.

II.—Manga.

Twig with leaves and pods.
Cotton seed.
Cotton.
„ with seed.
„ ginned.
Thread.
Towel (gamcha).

The thread is whiter than that of kherwa, and of better quality.

III.—Buria.

Twig with leaves and pods.
Cotton.
„ with seed.
„ ginned.
Dhuti.

The thread is of inferior quality, and coarse; strong cloths are made from it.

IV.—Bori.

Twig with leaves and pods.
Cotton seed.
Cotton.
„ with seed.
„ ginned.
Thread.
Towel (gamcha).

V.—Lurki.

Twig with leaves, flowers, and pods.
Cotton.
„ with seed.
„ ginned.
Thread.
Dhuti.

VI.—Jhit Boria.

Twig with leaves and pods.
Cotton.
„ with seed.
„ ginned.
Sari.

Cotton is not cultivated in this district on an extensive scale, and the outturn is never enough for export. The cultivating classes in the interior, and the aborigines on the hills, grow scarcely sufficient to meet their own requirements. It is understood that the wedding saris of the aborigines are made from home-spun thread. Imported fabrics are in general use for all other purposes on account of their cheapness. Twists and machine-made threads are largely imported.

MIDNAPORE DISTRICT.

Cotton with seed.
„ cleaned.
„ called bara kapas } and thread produced therefrom.
„ „ boria „ }
„ „ khera „ }
Coarse cloth manufactured by native weavers.

MUZAFFARPUR DISTRICT.

Sitamarhi Sub-division.

Coarse cloth.—Chiefly used for quilts, but by the lower classes of women for saris.

Cloth.—Used by the lower classes for salgas and dhutis.

Cloth.—Extensively used, on account of its durability, by the lower classes of women for saris, especially during the marriage season.

Home-spun yarns and threads.

Three sorts of cotton are grown in this sub-division, *viz.*, bhogla, bhochari, and dhakra.

The cotton produced is mainly used on the spot, but a small amount is exported to adjoining districts. The greater part of the cotton is used for making coarse cloths, quilts, etc., for winter use.

Cotton cultivation is decreasing, because the people prefer cloths of European manufacture, and because most of the cotton-producing land is taken up by Factory Managers for indigo cultivation at a higher rent.

MURSHIDABAD DISTRICT.

Sari.—Worn, on account of its coarseness, only by the lower classes, mostly Muhammadan females. Imported cloth of the same strength is

more expensive, so that the indigenous trade has not been affected, except that the thread is imported, and the upper classes, who formerly wore this coarse sari, now prefer imported cloth of finer texture.

Dhuti.—Worn, on account of its coarseness, only by the lower classes. The thread is imported. Imported cloth being more expensive, the indigenous trade has not been replaced. It is only worn by males, and seems never to have been used by the upper classes.

Bathing cloth (gamcha), made from imported thread.—Used by all classes, male and female, and preferred to imported towels owing to their cheapness, though they do not last so long.

MYMENSINGH DISTRICT.

Cotton cleaned.

Thread.

Bags manufactured by Garos of Bangaon and Nalitabari from cotton grown in the hills.

Bathing sheet.—Manufactured by native weavers. Used by all classes.

Balaposh (quilt).—Manufactured by tailors from cloth imported from Calcutta. Worn as a shawl in winter by middle classes.

Carpet (dari).—Manufactured by native weavers.

Dhuti.—From Jamálpur sub-division.

Napkin.—Manufactured by native weavers, and used by all classes.

Razai.—Manufactured by tailors from cloth imported from Calcutta. Used by middle classes instead of blankets.

Saris.

Sheet.—Manufactured by Hajangs from cotton called jagar. Formerly largerly used as under-sheet for beds.

Sheet.—Manufactured by Rájbansis, and worn by poor cultivators. In many places imported American cloth has taken its place.

Towel (gamcha).—Manufactured by native weavers, and used by all classes.

Towel (gamcha).—From Jamálpur sub-division.

Under-garment.—Manufactured by Garos. Can be utilised for carpeting if made on a larger scale.

NOAKHALI DISTRICT.

Cotton yarn.

Check cloth used for quilts and pillow cases.

„ curtain cloth.

„ dhuti.—Worn by old Muhammadans.

„ table cloth.

„ cloths.—Used for making shirts, coats, and trousers.

Yellow cloth.—Used for making shirts, coats, and trousers.
Dhutis.—Worn by boys.
Napkins.
Parda (curtain) cloths.
Sari.—Worn by girls.
„ Worn by old widows.
„ Worn by Muhammadan women.
Saris.—Worn by married Hindu and Muhammadan women.
„ Worn by Muhammadan married women.
„ Worn by girls.
„ Worn by girls and Muhammadan boys.
Sheets.—Worn by males.
Wrappers.—Used during the cold weather.

The above are made from purely home-spun, mixed home-spun and machine-spun, and purely machine-spun thread. The cloths being more durable than imported goods, are largely used by the lower classes; but the trade has dwindled down to one-half owing to the import of foreign goods. The cotton used is produced in the adjoining State of Hill Tippera.

NADIA DISTRICT.

Santipur dhuti and sari.—Santipur is noted for the manufacture of fine dhutis and saris, which are prepared from the best sorts of European thread (Nos. 220 and 230) imported from Calcutta. The price of a pair of best dhutis is ₹25, and of saris ₹30. The best kinds are not now ordinarily made, but the coarse cloths are extensively made, and supplied to Calcutta and other places.

The price of the dhutis and saris ordinarily sold varies from ₹2-8 to ₹12. In 1890-91 cloths were sold to the value of ₹67,000, against ₹1,00,000 in the previous year.

Santipur cloths were used on festive occasions and given as presents, but cloths made at Chandarnagar (Farasdanga) are preferred. The trade in cheap cloths has been replaced to a large extent by imported goods.

PATNA DISTRICT.

Dari (carpet).—Manufactured at Sultangauj, Patna City, to the value of ₹50,000 annually. The cost of a dari 7 feet × 3½ feet is ₹8.

Chintz.—Manufactured at Moghulpura, Patna City, to the value of ₹2,000 annually. It is sold at 6 annas per yard, and is used chiefly for making coats, trousers, etc.

The above are also imported from other places, the annual value of the imported goods amounting to ₹30,000 and ₹20,000 respectively.

Cotton manufactures are turned out on a larger scale at Fathwa and Bakhtiarpur. They consist of drapery (after English fashion), house-dusters, coarse and fine cloths for working into native garments, and handkerchiefs in imitation of good cambric.

Carpet.—Manufactured at Sultanganj Police Station.
Napkin; annas 1-9.
Red and blue-bordered teapoy cover; ₹2-8.
Towel; annas 6.
White damask table-cover; ₹2-8.
„ handkerchiefs; ₹1-8 per dozen.

Barh Sub-division.

Cotton leaves and flowers.
„ with seed, and ginned.
Thread.
Cloth.
Home-spun yarn and thread, and coarse cloths are made in this sub-division.

Bihár Sub-division.

Coarse white sari.—Generally worn by lower classes, called Telis and Koeris; ₹1-0-6.
Salu or turkey red sari.—Worn by the above; ₹1-9.
Red-bordered dhuti.—Worn by the above; annas 12.
Gamcha (towel).—Used by the above; annas 5.
Coarse cloth.—Used by the above for making quilts and razais.

Dinapur Sub-division.

Coarse cloth.
Sari.

Sadar and Dinapur Sub-divisions.

Cotton pods, 3-lobed and 4-lobed.
Cotton.
„ ginned.
„ flowers.

PURI DISTRICT.

Holdia cotton.—Grown on high lands during the rains, and harvested in winter.
Kora cotton.—Grown on low lands fit for rice cultivation during the winter, and harvested in summer.
Dhuti.—Woven by low castes.

Gouria sari. } —Woven by native weavers. The thread for the
Tounri „ } coloured border is imported.
Home-spun thread.

The home-spun yarns are used in making bedding, etc. Dhutis and saris are of the coarsest kind, and do not supply the wants of a hundredth part of the population. The place of indigenous goods has been almost wholly taken by imported goods or those manufactured locally from English thread.

PABNA DISTRICT.

Dhuti, black-bordered.
„ white „
Sari, black „

These cloths are made by the weavers of Sujánagar and Dogáchí. The thread is procured from Calcutta. European have, to a considerable extent, taken the place of indigenous manufactures. The saris and dhutis are mostly used by the upper and middle classes in Northern Bengal and the adjoining districts of other divisions, but have not an extensive sale.

SIRAJGANJ SUB-DIVISION.

Cloth called ananda-lahari.—Worn as sari by Hindus and Muhammadans; annas 12.

Gulbahar.—Worn by females of lower classes, Hindu and Muhammadan; R1-10.

Lungi.—Worn as a holiday dhuti, by middle class Muhammadans of both sexes; annas 10-6.

Cloth called urni.—Used as chadar by Hindu and Muhammadan gentlemen; R3, R1-6, and R1-4.

PURNEA DISTRICT.

Cotton, cleaned.
„ thread.
Brahmanical thread.
Gelap (winter cover).
Gazi (coarse cloth).
Sari with border.
„ without border.
Napkins.

RAJSHAHI DISTRICT.

Chadar.
Dhutis.
Bathing cloths (gamcha).

Matka (cloth).
Jhar mallika (jasmine-pattern cloth).
Cloth worn by young boys.
Handkerchief.

Cotton is cultivated to a very limited extent, to meet the demands of the Jolhas, who weave gamchas and coarse cloth. The indigenous weaving industry is nearly extinct, as it cannot compete with cheap European piece goods. Almost all the Bengal weaving class are gradually giving up their profession, and taking to cultivation and dealing in European piece goods.

RANGPUR DISTRICT.

Carpet manufactured at Nisbitganj.

The value of an ordinary carpet, 9 cubits long and 2¾ cubits broad, is ₹5-8, and its manufacture would take five to six days. The cotton is imported from Goalpara in Assam. The carpets are woven by Muhammadans in looms called 'panja' from their resemblance to the palm of the hand, and are purchased by Marwaris, who sell them at Dacca and other places at a profit of 25 to 40 per cent.

SARAN DISTRICT.

I.—Dasila Cotton.

Cotton, cleaned.
Garha or coarse cloth.
Dosuti.

This cotton is grown almost all over the Siwán sub-division, and forms the bulk of the produce.

II.—Bhogla Cotton.

Twigs with leaves and flowers.
Cotton cleaned.
Yarn spun by the growers.
Thread.

This cotton is grown almost all over the Gopalganj sub-division, and produces large capsules.

III.—Narma Cotton.

Cotton with seed.	Siwán sub-division.	
„ cleaned	„	„
Yarn	„	„
Pods.		

Chiefly grown in gardens. The capsules are long, and the fibre is

soft and white. It is consumed by the growers for manufacture, into quilts and sacred threads.

Twigs with leaves and flowers. From Gopalganj sub-division.

Pods.

The tree is a perennial grown in court-yards.

IV.—Kokti Cotton.

Cotton. From Gopalganj sub-division.

Thread. „ „ „

Yarn. „ „ „

Largely cultivated in Darbhanga and Muzaffarpur districts.

V.—Jethai Cotton.

Cotton with seed. From Gopalganj sub-division.

„ cleaned. „ „ „

Yarn spun by the growers. From Gopalganj growers.

Thread. „ „ „

Garha. From Gopalganj sub-division. Manufactured from mixed bhogla and jethai threads by native weavers for local consumption, and worn by the poorer classes.

Garha. Manufactured in the Sadar sub-division, and used for making razais, quilts, dhutis, chadars, etc.

SINGBHUM DISTRICT.

Cloths worn by Kol boys, aged 8 to 10 years.

Dhuti „ Bhuyias.

„ „ poor Kol women

Bathing cloth „ Kol youths.

„ „ „ adult Kols and Janti women.

„ „ „ Kols and Hindus.

„ „ „ Gonds.

[redacted] well-to-do young Kol women.

[redacted]ol, Bhuyia and Santal young women.

[redacted]ows of the weaver class.

[redacted]ti women.

[redacted]Kol and Janti women.

[redacted]t Santal women.

[redacted]nother of three or four children.

24-PARGANAS DISTRICT.

Baranagar dhuti, fine ; ₹2-2.

Sonarpur „ coarse ; annas 5.

Sonarpur gamcha, coarse; annas 2-6.
„ sari „ annas 12-6.
Nilambari sari, blue dyed, fine; R2.
Brahmanical thread.
The number of weavers in this district is fast decreasing, as they cannot compete with the mills.

SHAHABAD DISTRICT.

Coarse cloth, manufactured from kapas cotton for home use; annas 2-6 per yard.
Coarse cloth used largely by the poorer classes in Sásserám in the winter season. It is also sent by the weavers for sale at Hazáribágh and other neighbouring villages.
Charkhana (striped cloth).
Mirzapur coarse cloth.—More extensively sold than kapas cloth; annas 2-6 per yard.
Sainoo cloth.—Generally sent to Bhabua, Gaya and Arrah. Used for turbans, sheets, wearing apparel, etc.
Sozni cloth.—In Sásserám almost all the higher and middle classes use this as a bed sheet.
Cotton yarn.
The cotton grown in the district is sold to the poorer classes who sell the thread to the weavers, who manufacture the cloths. The weavers of Sahar make carpets from imported thread. The cotton and thread imported from the Mirzapur and other districts are largely used by the natives for weaving coarse cloth.

SONTHAL PARGANAS.

Deoghur Sub-division.

Dhuti; annas 12-6.
„ made by Jolhas; annas 8.
„ „ „ Tantis; annas 11-6.
Towel (gamcha); annas 4.
„ made by Jolhas; annas 3-6.
„ „ „ Tantis; annas 4.
Sari; annas 15.
„ made by Jolhas; annas 13.

Pakur Sub-division.

Cloth called elokeshi motiachla; R1-12.
„ „ doyal; R2-12.
„ „ jiabani motiachla; R2-14.
„ „ kantai motiachla; R2-14.
„ „ matapera motiachla; R1-14.

Dhuti; annas 13.
Sari; R1.
Motiachla sari; R1-12.
Towel (gamcha); annas 4-6.

RAJMAHAL SUB-DIVISION.

(*a*) Manufactured by Jolhas.

Goál gono sari.—Marriage cloth of Santals, given to bride's mother. Twist imported; R5.

(*b*) Manufactured by Jolhas and Momins.

Jola parila sari.—Worn by Jolhas and Santals; R1-12.

(*c*) Manufactured by Jolhas and Santals.

Chadar (pachari).—Used as a winter cloth, and given to Santal bridegrooms as a marriage cloth. Locally spun cotton and imported twist; R1.

Panchi dhuti.—Locally spun cotton and imported twist; annas 8.

Razai.—Worn by Santals, Paharias and Dikkus. Locally spun cotton and imported twist; R2.

Towel (panchi gamcha).—Locally spun cotton and imported twist; annas 8.

(*d*) Made by Tantis.

Bara satki sari.—Worn by Santals, Momins, Turis and Mohulis. Imported twist; R1-14.

Jarad kasta sari.—Worn by Santals and Dikkus. Imported twist; [illegible]4.

" kacha sari.—Worn by Santals. Imported twist; R1.

Sari worn by [illegible]ri.—Worn by Santals, Paharias, Turis and Mohulis.

" " K[illegible]

" " wi[illegible]orn by Santals and Dikkus of the Momin and

" " Jan[illegible]d twist; R2.

" " old [illegible]rn by Santals and Dikkus. Imported twist; R2.

" " adul—Worn by Santals and Dikkus. Imported twist;

" " the [illegible]

Phulas kacha —Mostly worn by Santals. Imported twist; R1-8.

Phulas santoshi sari.—Worn by Santals and Mohulis. Generally made from Bombay twist; R2-4.

Sádá kasta para sari.—Worn by Santals, Paharias, Jolhas, Momins, Turis, Mohulis and Mairas. Imported twist; R1-12.

JAIL MANUFACTURES.

Buxar-Central Jail.

Floor cloths (farash).—Manufactured to any size, and printed in various colours and designs. Largely used in India instead of carpets; annas 7 per square yard.

Dosuti, red (kharuah).—Largely used in the manufacture of tents for Civil and Military services; annas 6 per square yard.

Dosuti, blue (indigo).—Used in the manufacture of tents for Ordnance Department; annas 4-9 per square yard.

Dosuti, buff.—Dyed with a kind of yellow ochre (Multani mitti) from Multan. Used in the manufacture of tents; annas 4-6 per square yard.

Dosuti, white (double thread).—Extensively used on account of its durability in the manufacture of tents and for clothing; annas 4 per square yard.

Daris (design patterns).—Woven to any size and design on country hand-looms, and used as carpets; R2-8 per square yard.

Daris (striped patterns).—Woven to any size on country hand-looms, and used as carpets for tents manufactured in the jail; R1-8 per square yard.

Ghazi or dammer cloth.—Woven for use of Opium Department for lining opium chests; annas 1-6 per square yard.

Chauka cloth.—Used as intermediate cloth in tent manufacture; annas 2-6 per square yard.

Prison cloth, A class.—Used in all Bengal jails for making clothes for first conviction prisoners; annas 5-6 per square yard.

Prison cloth, B class.—Used in all Bengal jails for making clothes for habitual prisoners; annas 5-6 per square yard.

Hospital mattress cloth.—Used by Commissariat Department for Military Hospitals; annas 6-6 per square yard.

Hospital mattress cloth.—Used for making mattresses for European soldiers; annas 6 per square yard.

Chintz, hand-made.—Printed in various designs, and largely used as inner lining for tents; annas 5-6 per square yard.

Rope, twisted by hand.—Largely used in the manufacture of tents made in India; R1 per seer.

Tape, hand-woven.—Largely used in the manufacture of tents made in India; R1 per seer.

Dacca Jail

Carpet rugs; R4-8 each.
Dari; R4-8 each.
Towels, Dacca pattern; annas 12 each.
„ coloured; annas 8 each.
„ white; annas 8 each.

Check cloth.
Dusters; annas 4 each.

PATNA JAIL.

Ashwi (daris); R1-4 each.

MIDNAPORE JAIL.

Check cloths; annas 6 to annas 8 per yard.
Napkins, diamond pattern; R2-8 per dozen.
„ rib „ R2 „
„ flower „ R2-4 „
Dusters; R2 to R3 per dozen.
„ check; R2 per dozen.
Dusters, fine; R2-4 per dozen.
„ coarse; R2-8 per dozen.
Hand towels; R2 to R4-8 per dozen.
Parda (curtain) cloths; annas 2-3 per yard.

MADRAS.

MADRAS CHAMBER OF COMMERCE.

Sample bales of Cotton.

Good Westerns, R × D.
Fully good fair Westerns. Raichore Stone Cotton, 1892.
Fair ginned Coconadas. (Coco$\frac{s}{..}$)
Fair red Coconadas. („)
Good white Northerns.
Fair red Northerns (Coco$\frac{s}{..}$)
Good Tinnevelies. (Tin$\frac{y}{..}$)
Fully good fair Tinnevellies. (Tin$\frac{y}{..}$)
Good fair Tinnevellies. („)
Salem Cotton (average sample).

BUCKINGHAM MILLS, MADRAS.

Green Lion Yarn, 16*s.* and 20*s.*
Red gold „ „ 16*s.* „ 20*s.*

CORAL MILLS, TUTICORIN.

Twist 30*s.*
„ 20*s.*
„ 16*s.*
„ 8*s.*
„ 6*s.*

Spun from good, good fair, and fully good fair Tinnevellies. Sold in South India and China.

Sample bales of cottons from which the above were made.

CARNATIC MILLS, MADRAS.

Throstle Twist, 16*s.* and 20*s.* Gold seal on yellow ticket.
„ „ 16*s.* and 20*s.* Black „ „

TINNEVELLY MILLS, TUTICORIN.

Turbine Twist, 20*s.*
„ „ 16*s.*
„ „ 10*s.*
„ „ 6*s.*
} Sold in South India and China.

BELLARY DISTRICT.

ADONI.

Samples of twelve different sorts of carpets, and the yarns and threads used in their manufacture.

The colours used are white, light and deep red, brown, black, indigo and green.

The light red dye is obtained from a powder imported from Bombay. The colour is not lasting.

The yellow dye is imported from Bellary. The colour fades after a time.

The black dye is made of indigo, chunam (lime), and Fuller's earth.

The deep red dye is made of maddi root (*Morindra citrifolia*) castor-oil, and Fuller's earth.

The Indigo dye is of the same composition as the black dye. To obtain a black dye, the thread is allowed to remain in the liquid for a longer time than when an indigo colour is desired.

Green thread is imported from Bombay. The colour is not lasting.

CHINGLEPUT DISTRICT.

Turban made of Arni muslin, and yarns used in the manufacture R42-8.

COIMBATORE DISTRICT.

COIMBATORE TALUQ.

Cotton in capsule and ginned. } Vernacular *ukkam*. From Avarampala[illegible]m, Ganapathi, and Vilangkurchi villages.
Country thread. From Ganapathi village.
Cloth called reku.
Cloth used by all classes of Hindus.
Cotton rope and tape of various sizes. From Coimbatore bazar.

DHARPURAM TALUQ.

Cotton in capsule and ginned. Vernacular *ukkam*. From Puththur village.

ERODE TALUQ.

Bourbon cotton in capsule and ginned. Vernacular *punul*. From Sathmakur Uttukuli village.

PALLADAM TALUQ.

Cotton in capsule } Vernacular *ukkam* and *nadam*. Mathapur village.
„ ginned }

Cotton in capsule and ginned. Vernacular *nadam*. From Mannarai and Thotipalayam villages.

Country thread. From Nallur and Thotipalayam villages.

BHAVANI.

Samples of the following carpets, and yarns and threads used in their manufacture :—

Kanthimari.—Woven with blue and black and European red yarn.

Korvai.—Woven with European red and black yarn in alternate stripes.

Panchavarna korvai rettai kodi (five coloured korvai-double creeper).

Panchavarnam (five coloured).—Woven with European red, black, green and yellow yarns.

Rettai karam (twice alkalified).—Woven with deep-dyed red and black yarns in stripes.

Sannapattai (small striped).—Woven with red and black yarns in alternate stripes.

The country dyed red yarns are reported to be dyed by Pariahs at Nayinamallai in the Salem District, with dye obtained from the bark of *Morinda umbellata*.

To make the black dye, indigo is well ground with water, and the solution poured off. A quantity of thagaravirai (seed of *Cassia tora*) is well boiled, and mixed with the solution, and the mixture is kept for ten days. White yarn, if soaked in the mixture once or twice and dried, becomes blue, and, if soaked two or three times, a deep black yarn is produced. To prevent the mixture from acquiring a bad odour, chunam (lime) is occasionally mixed with it.

White yarn and thread are spun and twisted at Bhavani.

CUDDAPAH DISTRICT.

Lace cloth, gold embroidered. Manufactured at Pallampet; R14.

Yarn used in the manufacture of lace cloth.

GANJAM DISTRICT.

Muslins made at Ponduru and Chicacole:—

Red and blue spotted, 1st quality; ₹13-8.
„ „ „ „ 2nd „ ₹7-3.
Black spotted, 1st „ ₹13-8.
„ „ 2nd „ ₹7.

Country yarns with which the above are made.

KISTNA DISTRICT.

GUNTUR TALUQ.

Cotton in capsule } Vernacular *yerra patti* and *veru yerra patti*.
„ ginned } From Reddipalam village.

Country thread and cloths called cheera and dovatee worn by all classes of Hindus except Brahmans. From old Guntur village.

SATTENAPALLI TALUQ.

Cotton in capsule } Vernacular *yerra patti*. From Phirangipuram
„ ginned } village.

Country thread and cloth called reku, worn by villagers. From Phirangipuram village.

Hand-printed cloths.

KURNOOL DISTRICT.

CUMBUM.

Specimen of carpet called pancharangi.
„ „ „ chindidi.
„ „ „ dobbiri.

Dyed yarns used in manufacture of the carpets.

(I) *Pancharangi.*—The yarns used are all imported. As the name implies, it is of five colours, *viz.*, indigo, green, yellow, white, and red.

(II) *Chindidi.*—The colours are red, white, and indigo. The red yarn is English, and the white and indigo are of locally-made thread. The indigo colour is obtained by dipping the white yarn in a solution of indigo, Fuller's earth and conjee (gruel) of the seed of a plant called titakasindha (*Cassia occidentalis*). This is done at Cumbum.

(III) *Dobbiri.*—The colours are indigo and dirty red.

The indigo thread is the same as that just referred to. The red is purchased by the Cumbum carpet manufacturers from the dyers of the Nandyal and Tirvel taluqs. The red is said to be a vegetable dye obtained from the bark of a tree called maddichettu (*Morinda citrifolia* or *M. tinctoria*).

MADURA DISTRICT.

White cotton cloth, fine quality, with silver gilt border (R12), and yarns used in the manufacture.

Check cloths of different patterns made at Aruppukota, and yarns used in the manufacture. The dyed yarns imported from Europe. Cloths R2 each.

Block printed cloth; R3-4. Cloth imported from England and printed at Pamban.

Block printed cloth; R3-4. Country cloth printed at Pamban.

Block printed cloths; R1-4. Cloth imported from England, and printed at Paramakudi.

Block printed cloths. Made at Madura; annas 5.

NORTH ARCOT DISTRICT.

Cloths (English and country cloth) hand-painted with mythological figures at Kalahasti.

VELLORE JAIL.

CARPETS MANUFACTURED AT THE JAIL, AND DYED THREADS USED IN THEIR MANUFACTURE.

Colour.	Shade.	Materials used in dyeing.
Khaki	Light brown	Gall-nuts, alum, and sulphate of iron.
	Dark grey	Catechu, gall-nuts, and sulphate of iron.
	„ brown	Catechu, gall-nuts, sulphate of iron, and chunam (lime).
Indigo	Ink colour	Indigo, gall-nuts, sulphate of iron and alum.
	Brown ink	Ditto ditto ditto.
	Green	Indigo, murukambu, turmeric and gall-nuts.
	Light blue	Indigo.
	Dark „	Ditto.
Blue-stone	...	Blue-stone and chunam.
Brown	Light brown	Catechu, gall-nuts, palmyra jaggery, alum and chunam.
	Dark „	Ditto, with substitution of sulphate of iron for chunam.
Green	Light green	A little turmeric, indigo, murukambu, and gall-nut.
	Dark „	Ditto, but more indigo and turmeric.
Yellow	Various shades	Thovoer bark, turmeric and alum. Turmeric and alum. Murukambu, turmeric and alum.
Grey	...	Sulphate of iron.
Lime	...	Thovoer, gall-nuts and alum.
Red	...	Sappan wood, gall-nuts and alum.

SALEM DISTRICT.

Hand-painted English cloth with mythological figures; R18.
Block-printed English cloth; R6.
„ „ „ „ R4.
Hand-painted country cloth with mythological figures.

TANJORE DISTRICT.

Hand-painted cloth, made at Velipoliam. Used by Muhammadans and others at Singapore and other places out of India.

TINNEVELLY DISTRICT.

Otapidaram Taluq.

Cotton in capsule } Vernacular *karung kanni*. From Kiz Thataparai,
„ ginned } Malai Thataparai, and Otapidaram Villages.

Cotton in capsule and ginned (Vernacular *vellai kanni*), and country thread.
From Otapidaram Kaspa village.

Satur Taluq.

Cotton in capsule } Vernacular *karung kanni* and *uppam*.
„ ginned } From Malakkarandai village.

Cotton in capsule and ginned (Vernacular *uppam*). From Chinna Perali, Periya Perali, and Meelasur villages.
Country thread.—From Virudapatti Kaspa.

Tirumangalam Taluq.

Country thread.—From Tirumangalam, Kaspa, and Sengappadai.

VIZAGAPATAM DISTRICT.

Sari made at Rajam, and yarns used in its manufacture; R2-14.
The weavers purchase dyed thread from merchants in Vizianagaram, who obtain it from Bombay or Madras.
Cloths made from country yarn at Pondur; R6, R7, R8, and R9; and yarns used in their manufacture.
Embroidered sari made from country yarn at Pondur; R9-4.

NORTH-WEST PROVINCES.

Upper India Chamber of Commerce.

Sample bales of Cotton.

	Rate per bazar maund.	
	R	*a.*
M. G. Daisee	15	10
Madhogurh	15	2
Mahoba	15	2
Lakhna	15	0
Rampore	15	0
Kulpahar	15	0
Mursaini	15	0
Kauch	14	6
Satwara	14	6
Raut	14	6
Hyderabad	14	6
Manah	14	0
Kalpi	14	0
Kanauj	13	6
Alumpore	13	6
Kakoopur	13	2
Allyghur	13	2
Etawah	13	2
Pukhrawan	13	2
Pullia	13	2
Alligunj	13	0
Hurdoa	12	12
Mynpoory	12	12
Chipramow	12	6
Lahrapur	12	6
Cawnpore	10	12

Muir Mills Company, Cawnpur.

Honey-comb bath towels.
„ „ hand „
Toilet cover.
Counterpane, No. A.
„ material.
Twill sheet, No. 604.
Plain „ „ „
Dhuti, No. 630.
„ „ 540.
Floor cloth.
Chintz.
Bed ticking.
Striped twill.
Twill check.
Bedford cord.

Twill lining, No. A.
American drill, three kinds.
Dosuti, No. 1.
Mexican grey shirting.
T cloth, 40″, No. 1.
„ „ „ No. 2.
Blue cotton girthing, 4″.
Blue hemp „ 3½″.
Cotton „ 3″.
Hemp „ five kinds.
Cotton bobbing, machine-made, seven kinds.
„ „ hand-made.
Cops, Nos. 12, 16, and 24.
Tape of different kinds.
Desi cotton.
Hinganghat cotton.
Khangghaut cotton

CENTRAL PROVINCES.

SWADESHI SPINNING, WEAVING, AND MANUFACTURING COMPANY, NAGPUR.

Hinganghat cotton.	80/	Superior.	Serviceable for higher counts.	
Khandwa „	72/	„	„ „ „ „	
Nagpur „	55/	Fair	„ „ lower „	
Wardha „	72/	Good	„ „ higher „	
Swadeshi mills yarn, No.	22 4/7	Finest.	All consumed in Central Provinces market.	
„ „ „ „	20 4/3	Finer.		
„ „ „ „	16 3/14	Fine.		
„ „ „ „	12 3/8	Coarse.		
„ „ „ „	11 3/7	Coarsest.		
„ „ „ „	10 3/6	Coarser.		
„ „ „ „	6 2/15	Coarsest.		

ASSAM.

Cotton thread belts. From Naga Hills.
Garo hills cotton, with seed, in basket (toppa) in which it is carried on natives' backs.
Cloth manufactured by Garos.
Khasia Hills cotton, with seed, in basket.
„ „ „ ginned „ „
Cloth manufactured by Khasias.
Mikir Hills cotton, with seed, in basket.
„ „ „ ginned, „ „
Cloth manufactured by Mikirs.

CUTCH (CATECHU).

BURMA.

EASTERN CIRCLE.

Than sha (gum from the bark of *Terminalia Oliveri*) used for adulterating cutch.

PEGU CIRCLE.

Hard cutch. } From Tharawaddy and Yaw divisions.
Soft „ }

OUDH.

Khair (*Acacia Catechu*) wood, 1st quality, and chips.
„ „ „ „ 2nd „ „ „
„ „ „ „ 3rd „ „ „
Refuse khair wood chips after extraction of the catechu.
Kath (catechu) dried on cloth, 1st, 2nd, and 3rd qualities.
Kath dried on sand, 1st, 2nd, and 3rd qualities.
Kath as sold in the market.
Cloth dyed with kath.

The above specimens were sent from the Kheri division of the Oudh Circle.

NORTH-WEST PROVINCES.

Kath. From the Kumaon forests.

ASSAM.

Cutch manufactured in brass pots. } From the Darrang division.
„ „ „ iron „ }

BOMBAY BAZÂR.

Cawnpore catechu, superior quality.
Surat „ „ „
Imitation Rajapore catechu.

SURAT.

Cutch (Kathoo) from the Surat Forests, Bombay Presidency.

CALCUTTA BAZÁR.

Cutch, Pegu, No. 1. Imported from Burma.
" " " 2. " " "
Imitation soft Burma cutch (vel Pegu-salpatawala), Nos. 1 and 3.
Cutch called belguti ka logayan, No. 1.
" " janakpuri, Nos. 1, 2, and 3.
" " telá (adat), No. 3.
" " " (chaukhabi), No. 1.
" " " (mansaram), " 1.
" " " (telengar), " 1.

BARODA STATE.

Khair wood chips before being boiled, showing the white spots which indicate the presence of catechin.

Khair wood chips after being boiled. When dry they are used to feed the fire with.

Cutch, the resinous extract obtained by boiling down a decoction obtained from chips of the heart-wood of *Acacia Catechu*, is exported from India for use as a dye, tan, and medicine. In the United States miners and working men wear what are in India called khaki (dirt-coloured) clothes dyed with cutch. In India kath is eaten by natives in their pân (leaves of *Piper Betle*), and imparts with lime a red colour to the lips and teeth.

The quantity of cutch exported from all India in 1891-92 was 197,059 cwt., valued at R3,172,961. Of this quantity 86,882 cwt. w[redacted] shipped to the United Kingdom, and 61,796 cwt. to the United Sta[redacted]

FIBRES USED FOR BRUSH-MAKING.

A collection of the chief fibres used for brush-making in India was made for the Institute, the main object of which was to draw attention in England to the fibre of the "Sago Palm", *Caryota urens* (kittul or salopa) with a view to the possibility of India becoming a source of supply. This fibre was reported on as follows by an expert in the Madras Presidency: "This is by far the best fibre for brush-making that has as yet come before me. It is flexible and, at the same time, has stiffness and elasticity. By grading or sorting it can be used for various classes of brushes. The coarsest, it appears to me, would be a substitute for Piassava for bass brooms, while the finer can be used for other descriptions of brushes."

At present there is no regular trade in Indian kittul fibre for brush-making purposes, but there is no doubt that, if a demand for it arose, a very large quantity of the fibre could, within a few years, be annually exported and a large trade done.

Caryota urens.

KITTUL OR SALOPA.

MADRAS.

MALABAR DISTRICT.

a. Calicut taluq.
Black fibre.

b. Chirakhal taluq.
A. Black fibre.
B. Black and white fibre mixed
C. White fibre.

c. Ernád taluq.
A. Black fibre.
B. White fibre.
C. Black and white fibre mixed.

d. Kottayam taluq.
Black and white fibre mixed.

e. Kurumbranád taluq.
Black fibre.

f. Ponáni taluq.
A. Black fibre.
B. White fibre.

g. Walawanád taluq.
A. Black and white fibre mixed.
B. White fibre.
C. Black fibre.

h. Wynád taluq.
A. White fibre.
B. Black and white fibre mixed.
C. Black fibre.

Abstract of information regarding Kittul fibre that may be gathered in the District of Malabar.

Taluq.	Number of palms producing fibre in each taluq.	Estimated quantity of fibre available for export in a year.	Whether the supply could be increased if a demand for it arises.	The nearest seaport or railway station to which it could be sent, and the wholesale price per ton at which it could be landed there as reported by the Tahsildars and District Forest-officers.	The month in which the fibre can be gathered and exported.	Remarks.
		lb				
1. Chirakkal.	1,000	1,000	No, because people are averse to cultivate it, as the cultivation of cocoanut, etc., is more profitable.	Port Cannanore, R3,360 .	Can be gathered in October, and exported in December.	
2. Kottayam.	450	60	Do. do.	Port Tellicherry, R4,480 .	Can be gathered in March and April, and exported in April and May.	The Tahsildars of Wynaad, Ernád and Walawanád report that three kinds of fibre can be gathered. The Ponáni Tahsildar reports that two kinds of fibre can be gathered. The Palghat Tahsildar reports that no fibre can be gathered in that taluq.
3. Kurumbranád.	3,050	500	Do. do.	Ports Badagara and Quilandi, R2,240.	Can be gathered and exported in April-May.	
4. Wynaad .	12,500	6,300	Yes, if a reasonable price is [illegible]	Ports Tellicherry and Calicut, and railway station Calicut, R1,400.	Can be gathered in January and February, and exported in March and April.	

			do.	Railway stations Ferok and Calicut and Port Calicut, R1,500 to R2,240.	Can be gathered in December and January, and exported in April.
6. Ernád .	20,000	2,000	Do. do.	Railway station Ferok, Parpanangadi and Tirur, R300 to R600 for black fibre, and double the price for white fibre.	Can be gathered and exported from November to May.
7. Walawanád	25,000	6,250	Do. do.	Railway stations Pattambi, Ottapalam and Lakkadi, R300.	Can be gathered and exported from December to May.
8. Ponáni .	40,000	2,000	No, because palms are used for the more profitable trade of toddy drawing.	Port Ponáni; Railway stations Tanur, Tirur, Edakulam, Kuttipuram and Pallipuram on the south-west line, R3,000.	Summer season.
9. Palghat .	100	...	.....	.....	.....
10. Reserved Forest, N. Malabar.	3,000	2,240	Yes . . .	Port Tellichery and Nanjengod in Mysore, R2,260.	Can be gathered and exported from October to May.

COIMBATORE DISTRICT.

Black fibre.—From the Anaimalai hills.
Fibre from leaf petioles of male and female trees.

NORTH ARCOT AND TINNEVELLY DISTRICTS.

Fibre.

BENGAL.

a. Angul Division.

Fibre.

b. Puri Division.

Fibre.

c. Tista Division.

Stems.

Leaves.

Fibre obtained by soaking and boiling the stems in water.

d. Kurseong Division.

Fibre.

BOMBAY.

Fibre from leaf-stalk.—From North Kanara.
„ fruit-stalk.—From the Thana District.

BURMA.

PEGU CIRCLE.

a. Shweggin Division.

Floss, seeds, and fibre.
The woolly material (floss) found at the base of the leaves is so[redacted] times used for caulking ships in Burma.

b. Western Division.

Leaves.
Fibre from sheathing petiole and peduncle.
Stem of leaf soaked in water, and beaten out.

BHAMO AND KATHA DISTRICTS.

Fibre.

AMERICAN ALOE.

(Agave americana.)

Fibre from Coimbatore bazar, Madras.

In an article on brush-making fibres of India (*Indian Agriculturist*), December 12th, 1891, it is stated that "this fibre should be very easily procurable in India, as the American Aloe grows everywhere, and has been used already for fine fibre. But, as now we want a stout fibre, approaching, as much as possible, to the texture and quality of hog bristle, the methods previously used for the extraction of weaving fibre from this plant would probably not be successful in producing a good brush material. The most mature leaves should be selected for treatment, and it is very probable that the tall flower stalk would also yield a very valuable material, as it would be much longer in staple, and length is a very important factor in regulating the value of brush-making fibres. There is a good deal of gummy matter, which would have to be removed if the fibre was meant for weaving, but which is much better left where it is to a large extent, if the fibre is intended for brush-making purposes, as the gum lends stiffness and elasticity to the fibre—qualities that are much desired in this connection. It is obvious, therefore, that maceration in water should be avoided in this treatment, and some such process as drying the leaves and beating them dry is much more likely to produce a good stiff fibre. Of course a comb would be required to remove ragged ends and superfluous matter; but, if these fibres are carefully prepared and bundled in lengths, there is but little doubt that either or both of them might successfully compete with Mexican on the London market."

The Calcutta brush-makers import Mexican fibre (called in the vernacular *reju*) from England, and say that the fibre of *A. americana* [redacted] sufficient glaze to be as useful as Mexican.

PALMYRA PALM.

(Borassus flabelliformis.)

[redacted]bre obtained in Madras City.

[redacted]ibre prepared from the leaf-stalk and interior of the stem in the [redacted]h Arcot District, Madras.

Fibre, used for brush-making, from the Madura District, Madras.

Fibre from the Tinnevelly District, Madras.

Mature and fine fibre from the leaf-sheath, North Arcot District, [redacted]ras.

The Inspector General of Ordnance, Madras, reported that "an excel- substitute for piasaba is used by the Ordnance Department, which [redacted]btained from the Palmyra palm. It is, in my opinion, quite equal [redacted]razilian piasaba, and can be obtained in suitable lengths."

A writer to the *Madras Times* stated that a very good fibre can be extracted from the leaf-stalk of the Cocoanut and Palmyra palms, not so long but quite as strong as the Brazilian piasaba, and, if carefully extracted in its extreme length, sorted in bundles, and dyed brown the colour of piasaba, would certainly fetch a good price in the London market.

ARISTIDA SETACEA.

(Broomstick. Vínapullalu or Chíparapullalu.)

Roots sent from the Nellore District, Madras, by Mr. Brougham, Forest Officer, who reported that *vínapullalu* is in request among weavers, who make brushes from the roots, which in sandy soils, attain a length of from 2 feet to 3 feet, and, in hard soil, about 15 inches. The texture differs markedly according to soil.

CHUSAN PALM.

(Chamœrops fortunii.)

Fibre from palms introduced on the Nilgiri hills, Madras.

The whole of the trunk, from the ground up, is clothed with a thick mass of fibre, which only needs to be combed out and bundled in lengths to be a most valuable article for brush-making.

MUNJ.

(Saccharum ciliare.)

Stalks, and stalks beaten for making into whitewash br[redacted]

From Dehra Dun, North-Western Provinces.

BRUSHES SENT TO THE IMPERIAL INSTITUTE.

Fibre.	Place of manufacture.	Use.	Price. R	a.	p.
Aloe*	Calcutta	Painting	0	8	0
	Ditto	Mill brush	0	6	0
	Ditto	Carpet brush	0	6	0
	Ditto	Horse brush	0	10	0
	Ditto	Clothes brush	0	6	0
	Ditto	Wheel brush	0	6	0
	Ditto	Carpet brush	0	10	0
	Cawnpore	Horse brush	0	9	0
	Ditto	Carpet brush	0	5	0
	Ditto	Ditto	0	6	0
	Ditto	Boot brush	0	6	0
Cocoa-nut (coir)	Bombay	For collecting flour from sides of hand-mill	0	4	0
	Calcutta	Floor cleaning	0	7	0
Roots of **Cynodon Dactylon** (Couch grass).	Poona	Sizing wool fair even (used for blankets)	2	0	0
	Ditto	Used in manufacture of cotton cloth	2 to 3	4 to 8	0
Horse-hair	Bombay	Painting	0	1	0
	Ditto	Ditto	0	0	6
	Calcutta	Shoe brush	0	5	0
	Ditto	Clothes brush	0	6	0
	Ditto	Ditto	0	4	0
	Ditto	Cleaning cloth on loom	0	6	0
	Ditto	Carpet brush	0	7	0
	Cawnpore	Clothes brush	0	6	0
	Ditto	Boot brush	0	3	0
	Ditto	Ditto	0	4	0
	Ditto	Horse brush	0	6	0
...ir and Aloe.	Ditto	Boot brush	0	6	0
	Calcutta	Clothes brush	0	5	0
	Cawnpore	Ditto	0	6	0
	Ditto	Cleaning brass buckles, etc.	0	6	0
	Calcutta	Wall brush	1	0	0
...istle	Bombay	Cleaning gold and silver ornaments	0	4	0
	Calcutta	Scrubbing brush	0	13	0
	Ditto	White-washing brush	0	10	0
	Ditto	Chimney brush	0	4	0
	Ditto	Nail brush	0	4	0
...d horse-hair	Ditto	White-washing brush	0	8	0
...pogon, sp.	Ditto	Cloth brush	1	4	0

* Mexican fibre.

BRUSHES SENT TO THE IMPERIAL INSTITUTE.—*contd.*

Fibre.	Place of manufacture.	Use.	Price.
			R *a.* *p.*
Caryota urens (Kittul).	Calcutta . .	Horse brushes made from fibre steeped in mustard oil and unsteeped . .	0 12 0 and 0 10 0
Cocoanut . .	Ditto . .	Scrubbing brush . .	0 13 6
	Ditto . .	Deck brush, large . .	0 3 0
	Ditto . .	Ditto small . .	0 1 0
	Ditto .	Furniture brush . .	0 4 0
Horse-hair . .	Ditto . .	Stove brush . . .	0 14 0
	Ditto . .	Indigo brush . . .	0 6 0
	Ditto . .	Shoe brush . . .	0 8 0
Jute . . .	Ditto . .	White-washing brush .	0 8 0
Palmyra . . .	Ditto . .	Broom	1 8 0
Pig bristle and horse-hair.	Ditto . .	Hair brush . . .	1 0 0
	Ditto . .	Ditto	0 13 0
Saccharum Munja (Munj).	Dehra Dun .	Dusting brush . .	
Ischœmum angustifolium (Bhábar grass).	Ditto .	Ditto	
Andropogon muricatus (Khas).	Panjab . .	Weaver's brush . . .	2 0 0
Kittul (undressed. Lettering in coir).	Coonoor Brush Factory . .	Horse brush . . .	0 14 0
Kittul (oil dressed). .	Ditto . .	Ditto . . .	0 14 0
Kittul (undressed. Polished back).	Ditto . .	Ditto . . .	
Kittul (edged with horse-hair).	Ditto . .	Clothes brush . .	
Kittul . . .	Ditto .	Hair brush . . .	
Ditto . . .	Ditto . .	Scrubbing brush . .	1
Kittul and bristle .	Ditto . .	Ditto . . .	0
Bristle . . .	Ditto . .	Horse brush . . .	1
Cocoanut (coir) . .	Madras . .	Grooming cattle . .	0
Cocoanut (spadix) .	Ditto .	White-washing . .	
Aerial roots of . .	Ditto . .	Ditto . . .	0
Pandanus odoratissimus (Screw Pine).			
Roots of **Aristida setacea** (broom-stick).	Ditto .	Weaver's brush . .	4
Ditto . . .	Ditto . .	Ditto . . .	0

INDIGO.

BENGAL.

Samples of Indigo sent by Messrs. William Moran & Co., Calcutta.

G. H. G. Sugrampore Factory, Bhagalpur District.
G. & Co. Colgong „ „ „
H. S. & Co. B. Kattee „ Kishnagur „
I. & Co. N. Hazrapore „ Jessore „
H. M. J. Jungypore „ Murshidabad „
E. M. G. H. Gondwarrah „ Purneah „
R. J. & R. W. M. & Co., Rajapore Factory, Rajshahi District.
T. & M. Muttrapore „ Malda „
D. B. M. Motipore „ Tirhoot.
J. F. S. Shapoor Oondee „ „
M. & H. O. Olaha „ Champaran District.
Moran H. Hurraj „ „ „
K. R. Arrowah „ Chuprah „
H. R. & R. R. Nugwah „ „ „
C. F. & Co. Shapore „ Shahabad „
H. H. & Co. Camareah „ Mirzapur „
T. A. M. Bhawalpur „ Jaunpur „
M. C. T. Rahr „ Futtehpur „
T. P. (Native) Allyghur, Oudh.
„ „ „ „

DANDPORE INDIGO CONCERN.

Muzaffarpur District.

[illegible]ndigo leaves.
[illegible]ndigo before being pressed and prepared for the market.
[illegible] ready for the market.
[illegible]e indigo leaves from the vats after completion of the steeping

[illegible]r drawn from the heating vat immediately after completion of
[illegible]ng process.

CALCUTTA BAZAR.

[illegible]erican drill dyed of various shades.
[illegible]ed thread.
[illegible]n used for dyeing.

MADRAS.

(Madras Chamber of Commerce.)

North Arcot District.

Vellore indigo (dry leaf)—

1st quality,	value about	4*s.* 2*d.*	to	4*s.* 3*d.*	per	lb.
2nd	,,	,,	,,	4*s.* 1*d.*	to	4*s.* 2*d.*	,,	,,
3rd	,,	,,	,,	4*s.*	to	4*s.* 1*d.*	,,	,,
4th	,,	,,	,,	3*s.* 10*d.*	to	4*s.*	,,	,,

South Arcot District.

Ordinary native manufactured indigo (dry leaf)—

1st quality,	value about	3*s.*	to	3*s.* 2*d.*	per	lb.
2nd	,,	,,	,,	2*s.* 9*d.*		,,	,,
3rd	,,	,,	,,	1*s.* 9*d.*	to	2*s.* 2*d.*	,,	,,
4th	,,	,,	,,	0*s.* 10*d.*	to	1*s.* 1*d.*	,,	,,

Dry leaf indigo, locally known as *tulu saraku.*
Indigo seed and dust.

Cuddapah District.

Cocanada indigo seed and leaf.
Nandyal or Cuddapah indigo seed and leaf.
Razupalli mud used for adulteration of indigo
*Eugenia Jambolana** (Neridi) bark used in dyeing.
,, *alternifolia* (Movi) bark used in dyeing.
Cæsalpinia Sappan (Pathangi) wood used to give a false c
the dye. Red ink powder is now used as a substitute.

Razupalli mud is a pale-coloured earth found in the sub-s
field near Razupalli village, in the Cuddapah District, which is pu
by almost all the dishonest indigo manufacturers at 8 annas a cart-l
the purpose of adulterating the dye. About 15lb of the earth a
into a trough, and about 10 gallons of water added. The solut

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*Sent as *Jambosa vulgaris* (*Eugenia Jambos*), but probably *E. Jambolana.*

well stirred, and the sand, etc., is allowed to settle. The supernatant fine muddy solution is added to the Indigo decoction in the macerating or upper vat before it is emptied into the beating vat. As much as 6lb of this mud may be found in 25lb of indigo. The addition of the mud gives a false glossy appearance to the cake, and apparently increases its weight. The fraud is not easy of detection except by indigo experts. But about three months after the manufacture of the dye an insect is said to make its appearance and destroy both its quantity and quality. There are said to be very few manufacturers in the district who prepare the dye unalloyed.

IPECACUANHA.

Root weighing, after being dried by artificial heat, 1⅛ oz. of a plant which was put down at Nilambur, Malabar District, Madras, in 1884, sent to the Imperial Institute for analysis.

Mr. M. A. Lawson, Madras Government Botanist, reports that the Ipecacuanha plants put down at Nilambur five years ago are doing very well. Two roots from plants two and a half years old were analysed, and found to be of excellent quality. No root has as yet been put upon the market in Southern India, but Mr. Lawson has no doubt that this will be done shortly.

The plantation consists of 500 plants in an uncultivated soil. The rate of growth is very slow, but, where the soil is fairly loose and the plants are freely manured, the rate of growth is good, averaging at the end of four years 1 oz. 25 grains air dried.

IRON.

SOUTHERN DISTRICTS OF THE MADRAS PRESIDENCY.

Salem District.

Chromite; Chalk hills.
Iron ore; Belur, 3 miles north of Valaipádi, Attur taluq.
„ „ Kanjamalai.
„ „ Northern flanks of Kollimalai hills, 3 miles south of Namagiripett.
„ „ as mined by native smelters on the northern flanks of the Kollimalais.
„ „ obtained by crushing and sifting decomposed quartz-magnetite schist.
„ „ crushed and sifted; Mathurutu, Attúr taluq.
„ „ crushed and sifted; Namagiripett.
Iron shot, cast, cleaned for steel manufacture.
„ „ highly carburised. Used in steel manufacture, Namagiripett.
Magnetite; Kanjamalai.
„ sand prepared for furnace; Mathurutu, 4 miles west of Mallikari, Attúr taluq.
Quartz and magnetite.
Quartz-magnetite schist; northern flanks of Kollimalais, 3 miles south of Namagiripett.
„ „ „ mined by native iron-smelters on the northern flanks of the Kollimalais.
„ „ „ contorted.
„ „ „ decomposed. In fragments as mined by Native smelters; Murugathumalai, west-south-west of Attúr.
Slag from wrought iron furnaces; Namagiripett.
Steel made by decarburisation of cast-iron shot; Namagiripett, and Tammampatti, Attur taluq.
Wrought iron bloom; Namagiripett.
„ „ „ Tammampatti.
„ „ hammered; „
„ „ „ Karipatti.
Products of smelting:—
Bloom of wrought iron; Chendarapatti, Attúr taluq.
Highly carburised shot; Chendarapatti.
Slag; Chendarapatti.
Tuyères used in iron-smelting; Namagiripett.
Bellows, goat-skin, used by native smelters.

MALABAR.

Iron ore; Walluvanád taluq.
„ slag from site of abandoned workings, Angadipúram.
Laterite used as building stone; Angadipúram.
Magnetic iron-ore obtained by washing crushed quartz-magnetite schist; Ernád taluq.
Quartz-magnetite schist, mined for the iron-ore by Moplahs near Wandur, Ernád taluq.
„ „ „ crushed; near Wandur.
Slag from native iron smelting furnace, 6 miles east of Wandur.
Wrought iron from native furnaces, 6 miles east of Wandur.
Charcoal used by native iron-smelters near Wandur, made from *Albizzia amara* (*oosulay*).
Axe manufactured in Ernád taluq.
Bellows, goat-skin, used by native smelters.
Bolt, manufactured in Walluvanád taluq.
Digging implement manufactured in Ernád taluq.
Hammer manufactured in Walluvanád taluq.
„ wooden, used for crushing iron-bearing schist.
Knife, large, manufactured in Ernád taluq.
„ small, „ „ „ „
„ „ „ „ Walluvanád taluq.
Lamp with rod, manufactured in Walluvanád taluq.
Oil-pot „ „ „ „
„ spoon „ „ „ „
Ploughshare „ „ Ernád taluq.
„ „ „ Walluvanád taluq.
Rings for axe handles, manufactured in Ernád taluq.
Sickle, manufactured in Ernád taluq.
Spade „ „ „ „
„ „ „ Walluvanád taluq.
Spoon „ „ „ „
„ „ „ „ „

TRICHINOPOLY DISTRICT.

Bloom of wrought iron; Vairisettipalayam village.
Crude iron, manufactured from sand collected in jungle streams after floods.
Half bloom of wrought iron roughly hammered, used for wootz-making; Tuvarankurichi, Marangapari zemindari.
Iron (pieces) left behind during smelting, from which steel is manufactured; Vairisettipalayam village.
Iron ore.
Slags; Vairisettipalayam village.
Steel manufactured in Venkatanayakampatti, Marangapari zemindary.

Stone in which iron is found imbedded; Vairisettipalayam village.

Wootz ingots; Venkatanayakampatti.

Crucibles charged with wrought iron, wood and leaves for wootz-making; Venkatanayakampatti.

Crucibles as removed from the furnace with ingots of wootz inside; Venkatanayakampatti.

Crucibles, broken; Venkatanayakampatti.

Crucibles used in steel manufacture; Venkatanayakampatti.

Tuyères used in the wootz-making furnace; Venkatanayakampatti.

Wood of *Cassia auriculata* (*avári*), used in wootz-making crucibles; Tuvarankurichi, Marungapari zemindari.

CHINGLEPUT DISTRICT.

Magnetite, from 3 miles south of Chingleput.

COIMBATORE DISTRICT.

Magnetite, from Doddankombai forest, Satyamangalam taluq.

NELLORE DISTRICT.

Blocks of laterite.

BENGAL.

BARRAKAR IRON WORKS.

Bengal Iron and Steel Company.

Pig iron, No. 1 pig.
" " " 2 "
" " " 3 "
" " " " hard pig.
" " " 4
" " " 5 mottled pig.
" " " white pig.

Coal used in the blast furnace; from the Alipore colliery.

Steam coal, from the Kendwa pits close to the works.

Coke, used as fuel, made from coal from the Borria seam, 2 miles from the works.

Clay ironstone, from Begunia, 3 miles north of the works.

Limestone used as flux, from Koolbona, near Ramkanah railway station.

JUTE.

BENGAL.

24-PARGANAS.

(*a*) *Jute Fibre.*

Jute called bomi, fine, from Alipur.
„ „ lankagar, coarse „ „
„ several qualities „ Baraset.
„ called kartik shal, white „ „
„ „ rangipat, reddish „ „
„ „ desi pat, variety kartik shal, from Basirhat.
„ „ „ „ phal pat* „ „
„ „ guti pat „ phúl pat* „ „
„ „ „ „ phal pat „ „
„ „ hematgur, white, coarse and fine, from Diamond Harbour.
„ „ lankagar, red, „ „ „ „ „

(*b*) *Jute Cordage.*

Jute cordage, thick and thin, from Alipur.
„ „ „ „ „ Diamond Harbour.

(*c*) *Jute Rope.*

Jute rope, thick and thin, from Diamond Harbour.

(*d*) *Jute String.*

Jute string, fine and middling, from Alipur.
„ „ made from desi, variety kartik shal, lowest quality.
„ „ „ „ desi pat, variety phal pat.
„ „ „ „ „ „ phúl pat, soft, fine and strong.
„ „ thick and thin, from Diamond Harbour.

(*e*) *Gunny Cloths.*

Coarse and fine hand-made gunny cloth, from Basirhat.

In the Sadar Sub-division only twines and cordage are made. Gunny bags were formerly made in Thana Budge Budge, but the manufacture has ceased since the opening of the mills.

* Phúl pat derives its name from being prepared when the plant is in flower (*phúl*), and phal pat from being prepared after the plant has borne fruit (*phal*). Phúl pat is finer and softer than phal pat, and may be used for manufacturing cloth.

In the Diamond Harbour Sub-division the indigenous manufactures are string, rope, and cordage. These are mostly used for agricultural purposes, and in the construction of thatched houses.

In the Basirhat Sub-division nearly all the jute produced is sent to Calcutta for sale, only a small quantity being kept for domestic purposes.

In one or two villages hand-loom gunny is made to a small extent, but the manufacture has almost ceased owing to the production of machine-made gunny in Calcutta.

Jalpaiguri District.

Jute fibre, four varieties.
„ rope.
„ twine, three varieties.
Gunny cloth, five „

Jessore District.

1. Jute Plants.

(*a*) *Bangaou Sub-division.*

Chotna (desi). Prepared for, and after steeping.
„ (Dacca or Serajgunge). Prepared for and after steeping.
Dhaleswari. Ripe plant, and plants prepared for steeping.
Kartic sal (Patnai). Prepared for and after steeping.

(*b*) *Jhenidah Sub-division.*

Basijani kosta. Ripe plant, and plant prepared for and after steeping.
Harin. „ „ „ „ „
Kamarjani. „ „ „ „ „
Kamini. „ „ „ „ „
Meghlál. „ „ „ „ „
Sadu. Prepared for, and after steeping.
Singhi. „ „ „ „

(*c*) *Narail Sub-division.*

Bogi. Prepared for, and after steeping.
Mesta. „ „ „ „
Tita pat. „ „ „ „

(*d*) *Magura Sub-division.*

Bogi. Prepared for, and after steeping.
Deshwal. „ „ „ „

Kamarjani. Prepared for, after steeping.
Mesta. „ „ „ „
Dhaleswari. „ „ „ „

2. Jute.

Jute called bagi pat, from Jhenidah and Narail Sub-divisions.
„ „ baraipur chotna.
„ „ baran, from Sadar Station.
„ „ baran kartik shal, varieties.
„ „ bautabani.
„ „ bhaduri chotna.
„ „ bogi, from Magura Sub-division.
„ „ Dacca or Serajganj chotna.
„ „ deshi chotna, from Sadar Station and Bangaon Sub-division.
„ „ dhaleswari, from Bangaon, Magura and Jhenidah Sub-divisions.
„ „ ganjágali, from Sadar Station and Jhenidah Sub-divisions.
„ „ harin pat.
„ „ kamarjani.
„ „ kamini pat.
„ „ meghlál.
„ „ meghnath.
„ „ mesta, from Narail Sub-division and Sadar Station.
„ „ patnai, from Sadar Station.
„ „ patnai kartik shal.
„ „ shadu pat.
„ „ singi pat.
„ „ tita pat.
Jute rope, two-stranded and three-stranded.
„ string, two-stranded, from Bangaon and Jhenidah Sub-divisions.

3. Manufactures.

Gunny bag, from Magura Sub-division.
Twine, thick, „ „ „
„ thin, „ „ „

Midnapur District.

Jute stalks steeped in water, and unsteeped.
„ fibre, first, second, and third qualities.
„ string, „ „ „ „
„ rope.

PABNA DISTRICT.

Jute of good quality, called daria.

PURNEA DISTRICT.

Jute called dhamona, white.
" " " red.
" " meghlál, white.
" " " red.
" " muniashi or bochakandor.
String, thick and thin.
Gunny cloth, fine and coarse.

RAJSHAHI DISTRICT.

Jute, No. 1 and No. 2.
" best quality.
" inferior quality.
" red coloured.
" slightly reddish.
" white coloured.
" Durgapur outpost.
" called amnahmeeta.
" " ahmona, best and inferior qualities.
" " asin.
" " bhadoi.
" " dhona.
" " dudhsagar.
" " machat.
" " mesta.
" " shar pat.
" " tito or chati.

TIPPERA.

(*a*) *Sadar Sub-division.*

Jute called dhal sundari.
" " lali.
" " parbatia.

(*b*) *Chandpur Sub-division.*

Jute called dhal sandur.
" " kojali.
Hand-made gunny,

(*c*) *Brahmanbaria Sub-division.*

Spun jute called saralia.
Cordage.
Hand-made gunny.
„ „ „ cloth.

MESSRS. RALLI BROS., CALCUTTA.

1. Bundles—

R. B. 12/3 } Sirajganj District.
C. J. G. A. } Vicinity of Calcutta; desi (daissie).

Rungpur and Kuch Behar; Haldibari and Domar.

Coarse quality, used mostly by Calcutta mills.

R. F. B./D. Dacca and Mymensingh Districts.
C. J. A. Vicinity of Calcutta; desi (daissie).

2. Miniature bales—

C. J. A. Vicinity of Calcutta; daissie.
C. J. G. A. „ „ „
R. F. C. Dacca and Mymensingh Districts.
R. B. 2 Sirajganj District.
Red R. B. 2 Rangpur and Kuch Behar; Haldibari and Domar.

FORT GLOSTER JUTE MANUFACTURING COMPANY, CALCUTTA

Bag. No. 1 twill, 44″ × 26½″, 8 × 9, 2⅝ lb.
„ „ 2 „ 44″ × 26½″, 6 × 9, 2⅛ lb.
„ „ 2 „ 44″ × 26½″, 6 × 8, 2¼ lb.

Sugar bag, 48″ × 28″, 7 × 9, 2½ lb.
„ „ 36″ × 36″, 7 × 9, 1 lb 12 oz.

HOWRAH MILLS COMPANY, CALCUTTA.

Hessian cloth, 40″, 8 oz.
„ „ 45″, 11 oz.
„ wheat pockets, 36 × 22, hemmed, 12 oz.
D. W. bags, 56 × 28.

KAMARHATTY COMPANY, CALCUTTA.

Red striped woolpack, 54″ × 27″ × 27″, hd., 8 × 9, 11¼ lb.
New Zealand corn-sack, 48″ × 26½″, hd., 8 × 9, 2⅞ lb.
Australian corn-sack, 44″ × 26½″, hd., 8 × 9, 2¾ lb.
Red and blue striped A twill, 44″ × 26½″, hd., 8 × 8, 2½ lb.
Blue striped, No. 2 twill, 44″ × 26½″, hd.
Plain heavy C., 40″ × 28″, hd., 8 × 9, 2¼ lb.
Plain light C., 40″ × 28″, hd., 8 × 8, 2 lb.
„ „ K., „ „ 6 × 8, 1⅞ lb.
„ „ E., 40″ × 29″, unhd., 5 × 8, 1¾ lb.
„ „ „ „ , hd., 5 × 8, 1¾ lb.
Red striped E., 40″ × 28″, hd., 5 × 8, 1 1/16 lb.
Hessian wheat bag, 36″ × 22″, hd , 11 × 12, 12 oz.
R. W. striped Hessian pocket, 28″ × 18″, hd., 12 × 14, 9½ oz.
Hessian pocket, 34½″ × 20″, hd., 12 × 14, 13½ oz.
Egyptian cotton pocket, Hessian cloth, 45″, 11 × 12, 10¾ oz. per yard.

In the 'Statistical Tables for British India' it is stated that there were 25 mills working jute and one mill working hemp at the end of 1890-91, and employing a daily average number of 61,915 persons. The mills contained 8,101 looms and 161,845 spindles. The nominal capital of the mills worked by joint stock companies is stated in the returns at 31⅓ million rupees (£3,132,000, at the conventional exchange of 10 rupees to the pound); but the figures are not complete; for some of the mills no returns of capital having been furnished. Probably about 3½ or 4 million rupees may be added to the total on account of these. All but two of the mills are in Bengal, most of them in the vicinity of Calcutta.

MICA.

Rough and cut mica (Muscovite) from the Bengal mines. Obtained in the Calcutta bazár.

Raw and prepared mica (Muscovite), ruby-tinted. From the Gaya District, Bengal.

" " " " From the Monghyr District, Bengal.

The following specimens from the Inikurti mines, Nellore District, Madras:—

No.	Length.	Breadth.	Weight.	Remarks.
	Ft. In.	Ft. In.	lb.	
1	3 0	2 6	63¾	Excellent quality.
2	4 9	2 4	38¾	Good quality in part; about one-third corrugated parallel to prismatic cleavage.
3	3 6	2 4	38½	Good quality.
4	3 1	2 9	15	Good quality, but with numerous cleavage cracks.
5	1 8	1 8	10¾	Good quality.
6	1 4	0 5	2¾	Cleavage strips.
7	2 6	1 3	1½	Clear and comparatively free from flaws.

Mica (Muscovite) with infiltrated kaolin.

" " crumpled by movements of surrounding rocks.

" " with gleitflächen, parallel to the "pressure figures."

Collection of paintings on mica from Benares, Calcutta bazár, and Trichinopoly.

The mica used at Trichinopoly is purchased from the Marakoyers (a class of Muhammadans) of Negapatam, who purchase large quantities of mica every year from ships arriving from Calcutta, for making their big taboots for the Kanthiri festival.

Curtain spangled with mica. From Lahore.

Mica fans from Poona.

Fans ornamented with mica from the Calcutta bazár.

Mica ornaments (flowers, flower-trees, etc.) and lamps used in processions in Calcutta.

The United States are the principal consumers of Indian mica, and the quantity exported from India has increased coincidently with a falling off of production from the North Carolina deposits. It has been estimated that from Bengal alone there will be an output of 500 tons during this year, which is about one and a half times the production of North Carolina from 1868 to 1887, and more than fifteen times the amount raised in the United States in 1887.

MORINDA.

(ÁL DYE.)

NORTH-WEST PROVINCES.

(*a*) JALAUN DISTRICT.

Ál root, superior quality, grown in Kalpi; R8 per maund.
„ „ middling „ „ „ R5 „ „
„ „ variety katur, „ Tahsil Kunch.
„ „ „ tara, „ „ „
„ „ „ taraura, „ „ „
Coarse printed cloth, called doga, used for quilts and mattresses.
Coarse printed cloth, called gárhá.
Dyed dhuti made of American fabric.
Spotted cloth, called chunri, used as a shawl. The spots made by tying knots in the cloth before dyeing.

(*b*) JHANSI DISTRICT.

1.—Substances used in dyeing:—
Al roots powdered; first and middling qualities.
Alum.
Buchanania latifolia (?) gum (gond kandá).
Cæsalpinia Sappan (patang) wood.
„ „ „ „ powdered.
Castor oil.
Gums, mixed (gond).
Indigo.
Impure soda (rassi).
Lime.
Red ochre (geru).
Terminalia Chebula (harrá) fruit.
„ „ „ „ powdered.
Woodfordia floribunda leaves, chopped twigs and flowers (dháwai).

2.—Fabrics:—

Coarse country cloth, called ikri—
First quality; R1-6.
Cloth treated with Terminalia Chebula fruit.
„ „ sheep-dung, castor oil and alum.
„ printed and made into chintz, called zamurradi nathoni; R1-8.
„ „ „ „ „ „ chapaita; R1-8.
„ „ „ „ „ „ agrawar; R1-4.
„ „ „ „ „ „ lahariadar; R2.

Coarse dyed cloth, called kharuá; R2.
Dyed cloth; R2.

(*c*) LALITPUR SUB-DIVISION.

Ál roots, powdered.
Alum.
Terminalia Chebula fruit.
Undyed cloth.
Cloth treated with Terminalia Chebula.
" " " alum and Terminalia Chebula.
" " " " Terminalia Chebula, and ál.

CENTRAL PROVINCES.

DAMOH DISTRICT.

Ál roots, thick, middling and thin.
The cultivation is said to be on a small scale and decreasing. The manufacture of dyed cloth is not an industry of any importance.

CALCUTTA BAZÁR.

English muslin dyed with ál.
Country kharuá cloth dyed with ál.
Country gazi or gárhá cloth used for dyeing with ál.
Thread dyed with ál.
Record box covered with ál-dyed cloth.

Of late years ál root has been occasionally sent to Europe, but no regular foreign trade in the dye-stuff appears to exist. The colour yielded is a fast but dull red, and appears to have little chance of competition with the colours obtained from madder. It is possible, however, that certain of the orange and golden yellows obtained by Mr. Wardle may find favour, and thus open out a field for foreign trade in the dye. One of the most remarkable properties of cloth dyed with ál is the fact that it is not attacked by white ants, and on this account it is used in India to wrap round the account books of bankers and shop-keepers, and might with advantage be more generally used for binding books and record boxes, and other purposes for which protection from insects is a desideratum.

PADAUK TIMBER.

(Pterocarpus indicus.)

A fine log, about 16′ × 4′ × 3′ 4″, with one face polished, has been set up at the Imperial Institute, and it is proposed to panel the Indian Conference Room with timber received from the Andaman Islands.

The padauk tree grows abundantly in the Andaman Islands and Burma, and has within the last few years been introduced into the European market. The timber is about as hard as teak, is capable of taking a high polish, and is considered to be admirably adapted for furniture, panel work, parqueterie, windows, doors, etc. A large quantity of the timber goes eventually to France and Belgium for panelling, and it has recently been favourably received in America.

The London Agents for the timber are Messrs. Ogilvy, Gillanders, & Co.

PODOPHYLLUM EMODI.

Roots and rhizomes procured by the Conservator of Forests, Panjab.

Resin, prepared by the British Pharmacopœia process, sent by Messrs. Kemp & Co., Pharmaceutical Chemists, Bombay.

The plant is met with in the higher, rich and shady temperate forests from Sikkim to Simla, Kashmir, Hazara, Tibet, the Kuram Valley and Afghanistan. The American species (*P. peltatum*) affords the officinal root of commerce, and India imports the resin, podophyllin. The Indian root has been found, by analysis, to afford 12 per cent. of the resin as compared with the American 4 per cent.

In a paper read before the British Pharmaceutical Conference by Mr. Umney in 1892, it was stated that "the rhizome of *Podophyllum emodi* yields nearly double the amount of resin yielded by *P. pettatum*, but that resin contained only about half the quantity of crystallin picropodophyllin to which the value as a cathartic is due." Mr. Umney recommended that the Indian drug should not be used as an alternative source for the preparation of the officinal resin in the British Pharmacopœia. No conclusion should, however, be drawn until an exhaustive clinical and physiological examination of the resin has been made.

RESIN AND TURPENTINE FROM INDIAN PINES.

NORTH-WEST PROVINCES.

Crude resin, Resin, Pitch } From *Pinus longifolia.* Manufactured at Dehra Dun.

Crude resin, Resin } From *Pinus excelsa.* Manufactured at Dehra Dun.

Turpentine distilled from mixed resins of *P. excelsa* and *P. longifolia* at the Imperial Forest School, Dehra Dun.

NORTH-WEST SOAP COMPANY, MEERUT.

Cakes of soap prepared with 10 per cent. of eucalyptus oil from *Eucalyptus globulus* grown on the Nilghiri hills, Madras.

Cakes of soap prepared with 10 per cent of turpentine manufactured at the Forest School, Dehra Dun.

Mottled curd soap made from tallow and cocoanut oil, and free from resin.

Pale yellow bar soap prepared with tallow, cocoanut oil, and resin of American manufacture.

Household soap prepared from tallow and resin manufactured at the Forest School, Dehra Dun.

The soap prepared with the resin made at Dehra Dun is darker in colour than, but otherwise of nearly as good quality as that prepared with American rosin.

In a note on the resin-tapping industry at Dehra Dun it is stated, in the Report of the Forest Department, North-Western Provinces, 1890-91, that "this industry promises to become one of great importance in the hills. The rosin was all sold to the Meerut Soap Company, but so far the turpentine has not sold well, although those who have tried it have pronounced favourably on its quality. All it wants is to be known." The Dehra turpentine cannot at present aspire to conquer the Calcutta market, which is too far away, and requires too much; all it can hope to do is to obtain a good sale in Upper India. If the Forest Department could get R3 per gallon, all round, for Dehra turpentine, it would be worth while to build a factory and manufacture it and resin.

ASSAM.

Resin and crude turpentine from *Pinus Khasya.*

The Conservator of Forests sees no reason why the forests should not be worked for resin and turpentine, especially in the Shán States.

SIDA FIBRE.

(*a*) Sida rhombifolia var. rhomboidea.

(*a*) Fibre from plants cultivated as an experiment at the Cossipur Practical Institution of Horticulture, Calcutta. The plants were cut down in November when five months old, and steeped in water for ten to sixteen days. The fibre was then separated, washed in water, and dried for a day or two in the sun.

(*b*) Fibre from plants cultivated in a village near Calcutta.

(*c*) Fibre from plants growing wild in the jungles; sent by Rája Kristendro Roy, of Balihar, Rajshahi, Bengal.

The plant grows abundantly in moist waste lands in Bengal, but is said at present hardly to repay the trouble and expense incurred in its cultivation.

(*b*) Sida carpinifolia.

(*a*) Small specimen of fibre sent by Mr. Brougham, Forest Officer, Nellore District, Madras, who stated that the plant grows wild and springs up after the north-east monsoon, and could be easily cultivated at little cost. The fibre was extracted by beating the stems with a wooden mallet, and washing during the intervals of beating

(*c*) Sida cordifolia.

Plant, bark, and fibre sent from Lahore.

The Director of Agriculture, Panjáb, reported that the plant admits of plantation on a large scale, and that consequently a large quantity of fibre could be produced. The fibre is at present not a market article, and the production would cost about ₹6 per ℔. But if the production was extended, the cost would probably be reduced to ₹2 per ℔ or less.

Sida fibre has been reported by an expert as being a strong, fine, round fibre, of excellent spinning properties, fit for higher purposes than jute, and has been recommended to the consideration of flax manufacturers. The suggestion has been made that the fibre might be successfully grown over a wide area where jute cultivation is impossible, and that Southern India or Bombay would prove better suited for the development of a Sida industry than the damper regions of Bengal.

SILK.

BENGAL.

Collection made by Mr. N. G. Mukharji on behalf of the Government of Bengal.

(*a*) **Bombyx crœsi** (Nistri or Madrassi).

Larvæ in spirit.
Cocoons.
„ (dhali) obtained by a process of selection.
Silk, native hand-reel.

(*b*) **Bombyx fortunatus** (Desi or Chota Polo).

Larvæ in spirit.
Cocoons.
Silk, native hand-reel.
„ „ filature.

(*c*) **Bombyx mori.**

Cocoons, annual, from China seed. Reared at Kalinpong, Darjiling.
„ from Japan seed. Reared at Khulna, Bengal.

(*d*) **Bombyx textor** (Boro Polo or Large Pat).

Larvæ in spirit.
Cocoons, annual.
Silk, variety Kangru, native hand-reel.
„ native filature.
„ „ thrown. From Berhampore.
„ thread, coarse. Made from pierced cocoons with spindle, and used for making matkas.
Silk thread, bleached and dyed. From Berhampore.
Waste silk (tape), native hand-reel. From Berhampore.
„ „ basin. Native filature.
Baluchar charkhana cloth; ₹2-3.
„ „ „ ₹8.
„ „ „ ₹12.
„ reyia. Exported to Assam; ₹10.

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* The Bombay and Punjáb collections of silk will be dealt with in 'Guide to Commercial Collections,' No. 2.

Silk skirts made from Baluchar charkhana. Worn by Jains, R4-4.

Mirzapur rekhi; R19-3-3.

„ jor (dhuti and chadar woven in one piece); R15.

„ handkerchief, plain; annas 14.

„ „ bordered; annas 10.

„ muslin, striped; R7.

„ „ plain; R11.

„ check cloth; R21.

„ gown-piece; R21.

„ sari. Worn by Bengali ladies; R26.

„ „ R12-8.

Berhampore kora (unfinished). Knotted for making mohanbani. The knotting takes three days to do, and is done by women, who are paid at the rate of one anna per diem; R5.

Berhampore kora. Knotted, preparatory to dyeing, for making matichur. The knotting takes fifteen or sixteen days to do, and is done by women, who are paid only ten annas for the whole operation. These korahs are used by women of the North-West Provinces and Punjab for making skirts; R5.

Knotted kora, called teparta. Exported to Burma.

Kora. Exported to Europe, and used for lining, printing, etc. The bleaching is done in the piece, not in the thread; R6-8.

Kora, called namabali Printed with religious texts; R4.

Berhampore handkerchief, called phulikat. Exported to Rangoon; R1-2.

Berhampore matra. Exported to Arabia; R4-8.

„ matka matichur. Used by women of the North-West Provinces and Punjab for skirts; R3-8.

Berhampore cheli; R6.

„ chaukara. Exported to Arabia; R18.

„ pagri; R1-4.

„ dhari on the loom.

Islampur Chak matka dhuti. Made all over the Murshidabad District, but principally at Islampur Chak. Worn by people of the Deccan after bathing; R4-4.

Islampur Chak matra sari. Also made at Goaljan and other villages near Berhampore. Worn by Mahratta women; R5-4.

Mirpur shawl, also used as table cloth, dyed with fast colours, except the green; R36.

Mirpur scarf; R6-8.

Mirzapur charkhana, superior quality.

Azimganj mekhla, embroidered with gold by a Jain. Cloth imported from Europe; R23.

Latai for winding matka thread from spindle.

Shuttles made at Berhampore.

Native-silk-loom.

The following note on the silk industry of Murshidabad is extracted from a Report to Government by Mr. N. G. Mookerji in 1891 :—

Decline of the Industry.

The decline of the silk industry of Murshidabad in the department of artistic fabrics is more rapid and intense than in any other department. The trade in these fabrics is chiefly inland, and no exact information, such as can be obtained of the slower decline in the export trade, or of the more rapid progress of the import trade in silk, is available for the trade in the Murshidabad artistic fabrics generally. The evidence of this decline is abundantly clear in the villages themselves where these fabrics are made. Less and less is becoming the income of the weavers, and everywhere they point out to strangers the ancestral brick-built houses now in ruins, while they themselves live in thatched cottages. Fewer and fewer looms are employed in silk fabrics, and the weavers are taking to other occupations. The unnatural state of sterling exchange that prevailed for a few years gave a temporary impetus to the korah trade which has again sunk to a very low level.

The causes of the decline of the industry are summarised by Mr. Mookerji as :—(1) ignorance of the weavers; (2) poverty of the weavers; (3) decline of the Hindu religion; (4) decline of taste; (5) want of patronage; (6) the introduction of fugitive dyes, poor and untwisted silk, and heavy sizing.

Destination.

A small proportion of the fabrics is consumed in Bengal, the rest being exported to other provinces or to other countries. The costliest fabrics are used in Bengal Proper and in Assam. (1) In Bengal only are the highly artistic products utilised. These are the Baluchar butedars, dhutis, saris, jors, the better classes of chelis, gown-pieces, *hawai* goods, rekhis, scarfs, shawls, alwans, charkhanas, and plain and bordered handkerchiefs. (2) To Europe korahs only are exported. Printed handkerchiefs used to be exported from this district only a few years ago, but it is no longer done. (3) To Bombay poor chelis and korahs for printing are sent. (4) To Rangoon are exported phulikat handkerchiefs and banhus. European prints and handkerchiefs of more correct and showy patterns, and of less price, are gradually replacing Bengal articles in Burma. (5) To the North-Western Provinces and the Punjab are sent matichurs or churis made out of matkas or korahs. (6) To Arabia are sent dharis, chaukaras and matras. (7) Reiyas and mekhlas, with or without gold embroidery, are sent to Assam. Chadars, made in the style of eria chadars of Assam manufacture, are made out of mulberry silk waste in this district and sent to Assam. (8) To all parts of India where Mahrattas live, matkas with or without fringe, white, coloured, or checked, are sent, and there is a very large trade in this article. The three firms of up-country merchants at Berhampore

mentioned before trade chiefly in matkas. (9) Korahs and chelis are exported to most parts of India. Chelis are used for ceremonial purposes all over the country, and they are also used for lining purposes.

Dyeing.

The colours chiefly used in the artistic fabrics of Murshidabad are five—(1) red, (2) yellow, (3) green, (4) purple, and (5) *banesh* or chocolate, besides white. There is properly speaking no black dye. What is called black is simply deep indigo or deep chocolate. To dye the silk black it is put several times in the indigo vat. Where the deep chocolate black is wanted, the silk thread is first dipped in a vat containing a mixture of *saji* (crude sodium carbonate) and arnatto. The thread so dyed with arnatto colour is put in a vat containing lac dye. It is now dyed deep red. A third dyeing with indigo finishes the operation. Light colours generally are in rare use, although the cost of dyeing thread light is less than dyeing it deep.

Bleaching is done before dyeing, except where arnatto is used, when bleaching and dyeing are performed in the same operation by boiling the thread in a mixture of saji and arnatto. The bleaching is done by boiling the thread in water to which the ashes of plantain trees and carbonate of soda are added. After about a quarter of an hour's boiling, the thread is washed thoroughly before putting it in a tepid solution of alum preparatory to dyeing, except when arnatto is used, when no previous mordant is required. In the process of bleaching silk loses a quarter of its weight.

Green.—This is the only native dye in use in this district which is not fast. Fast green is known in other parts of India, but not in Murshidabad. The thread taken out of alum is boiled in a decoction of bákash (*Adhatoda vasica*), to which a quantity of saw-dust of the jackwood (*Artocarpus integrifolia*) is added. The thread is then taken out and dried, and afterwards put in a solution of light indigo. Usually 24 ounces of bleached silk weigh 26 ounces when it is dyed. In the rainy weather when silk is dyed *green* it becomes heavier, *i.e.*, 24 ounces of bleached silk become 28 ounces. This difference does not occur in the case of the other dyes. To dye a seer* of bleached silk green costs Rl-2.

Yellow.—(1) The bleached thread prepared with alum is put in a solution of orange-peel dust. Saw-dust of bakam (*Cæsalpinia Sappan*) wood is sometimes added.

(2) Unbleached thread is put in a solution made with saji and arnatto and boiled, and then washed.

(3) The bleached silk is put in a solution made with lodh (*Symplocos racemosa*) wood and boiled, a little arnatto dust being added to the mixture. No alum is used in (2) and (3).

These three processes produce three different shades of yellow, none of which are pure yellow. The cost in every case is 8 annas per seer.

* A seer = 2lb.

Purple.—The thread prepared with alum is put in lac dye, and afterwards in a solution of indigo. The lac dye used is weak. Dyeing the thread light red costs 6 annas per seer, and the subsequent blueing 17 annas per seer.

Blue.—Blue colour is rarely employed, as it costs R2 per seer to dye blue; indigo being the costliest dye in use. Very deep indigo, called black, costs still more, as it requires two, three or more successive dyeings in the indigo vat.

Banesh or chocolate.—The thread prepared with alum is put in lac dye, and then becomes red. The thread so dyed is put in a weak solution of indigo. This costs 17 annas per seer of bleached silk.

Pink is simply light red, and dyeing of bleached silk pink costs 12 annas per seer.

Red.—The thread prepared with alum is first dyed with lac, and subsequently dyed with turmeric. This costs R1-4 per seer.

The use of bright but fugitive anilin colours has become the rule in most weaving establishments in this district, as the demand is growing for cheap and bright-looking articles. The addition of sugar with the sizing also improves the look at the sacrifice of the silk fibre.

MESSRS. JARDINE, SKINNER & Co., CALCUTTA.

(*a*) **Bombyx fortunatus** (Desi or Chota Polo).

Cocoons. Cold weather bund.
Silk „ „ Coomercaly G. A.
„ „ „ Surdah S.
Cocoons, white.
„ yellow.

(*b*) **Bombyx sinensis** (Sina, Cheena, or Chota Pat).

Cocoons, white.
„ yellow.

(*c*) **Bombyx textor** (Boro Polo or Large Pat).

Cocoons, blue.
„ white.
„ yellow.

BANKURA DISTRICT.

Vishunpur.

Duria sari, made with European twist and tasar silk thread, R1-2-6
Coloured silk comforter; R1-7
White „ „ R2.
„ „ dhuti; R12.
„ „ than; R17.

Coloured silk scarf; ₹8.
„ handkerchief; ₹1-8.
White „ „ annas 14.
Coloured „ waist-band (kamarband); ₹3.
Red silk sari; ₹20.
Mixed cotton and silk cloth, called kutni; ₹6.

BIRBHUM DISTRICT.

Bafta dhuti; tasar silk and cotton mixed; ₹5.
Tasar cloth; ₹10.

BOGRA DISTRICT.

(*a*) **Attacus ricini** (eri or endi).
Endi cocoons.
„ thread.
„ cloth.

(*b*) **Bombyx fortunatus** (Desi or Chota Polo).
Cocoons.
Raw silk.
Handkerchief.

BURDWAN DISTRICT.

Cheli; ₹15-6.
Tasar silk.

DINAJPUR DISTRICT.

Endi (**Attacus ricini**) cloth.
„ „ „ thread.

MANBHUM DISTRICT.

Tasar cocoons, called ampata phuki.
„ „ „ bodra, and thread.
„ „ „ bogui.
„ „ „ dava, and thread.
„ „ „ jarui.
Plain tasar cloth.
Twilled „ „

MIDNAPUR DISTRICT.

Bombyx fortunatus (Desi or Chota Polo).
Cocoons.

MURSHIDABAD DISTRICT.

Tasar fishing lines, 1st to 8th sorts.

Mymensingh District.

Endi (**Attacus ricini**) thread.
„ „ cloth.

MADRAS.

Bellary District.

(*a*) *Hospet Taluq.*

Silk sari made at Kampli; ₹40, and skeins of dyed silk used in its manufacture.

Raw, twisted, undyed and dyed silks used in the manufacture of silk cloths. Materials used in dyeing:—

Cochineal (kirumanji).
Bixa orellana (kapeli) seed.
Mallotus philippinensis (kapeli) powder.
Galls (pisi kayi).

(*b*) *Hadagalli Taluq.*

Silk cloths used for women's bodices, manufactured at Hampasagaram, Bachigondanahalli, and Tambrahalli, and silks used in their manufacture.

Kollegal, Coimbatore District.

Bombyx meridionalis.

Cocoons.

Best Indwari raw silk. Prepared in native reel.

Raw silk. Prepared at the Mylitta Mills. The greenish yellow colour has been entirely removed by using soap nuts (*Sapindus emarginatus*) in the water of the reeling basin.

Warped silk.—The process of warping consists in placing the silk in a boiling solution of washing soda, keeping it constantly stirred for about six hours. It is then slowly removed, washed well in cold water, and dried. In this way the silk is bleached. One seer of raw silk requires one seer of washing soda.

Dyed silk, violet.—The warped silk is immersed for six hours in a cold solution of ammonia-alum, and, after being dried, dipped in a solution of violet ink powder or aniline violet. One seer of silk requires three tolas of alum.

Dyed silk, green.—The warped silk, treated with alum as above, is immersed in a cold solution of turmeric for an hour or two, dried, and then boiled in a solution of aniline green for nearly on hour and a half, after which it is washed and dried. One seer of silk requires two tolas of turmeric powder.

Dyed silk, yellow.—After treatment with alum the warped silk is boiled in a solution of turmeric for two to three hours, washed, and dried in the shade, as strong sunlight acts prejudicially on the dye.

Dyed silk, orange.—After treatment with alum the warped silk is boiled for nearly two hours in a solution of kamela (*Mallotus philippinensis*) and arnatto (*Bixa orellana*), washed and dried. One seer of silk requires half a seer of kamela powder and 6 tolas of arnatto seeds.

Dyed silk, rose.—After treatment with alum the warped silk is boiled in a solution of rosanilin for an hour, washed and dried.

Dyed silk, crimson.—To the alum solution turmeric is added, and the warped silk is boiled in it for nearly six hours. After washing and drying the silk is boiled, with frequent stirring, in a solution of triturated cochineal and gall-nuts for two hours, washed and dried.

Dyed silk, lac.—The silk is treated with alum, remaining in the solution for about six hours. Finely powdered stick lac is boiled in water, and the clear red-coloured water collected. Water is added to the precipitate, and boiled with frequent stirring. This process is repeated till all the red colour is extracted from the lac. The collected water is then boiled with admixture of tamarind water, and the silk boiled in it for three to four hours, washed, and dried in the shade.

Dyed silk, black.—A solution of indigo is made in a basin or vat, and in another vessel a dilute solution of washing soda is made and, after standing for eight hours, filtered. The two solutions are then mixed with frequent stirring. To the mixture a paste prepared from *Cassia tora* is added.

The indigo solution thus prepared is sealed, so as to be air-tight, for twenty-one days, after which it is opened and the silk dipped in it and dried. After drying, castor-oil is rubbed into the silk to give it a polish and brilliancy.

Tanjore District.

Mixed cotton and silk cloth, called karkana visiri. Made at Kuttalam. Worn by Hindu ladies; ₹15.

Mixed cotton and silk cloth called pappali. Made at Kuttalam Worn by Hindu ladies; ₹15.

Mixed cotton and silk cloth, called kurai sélai. Made at Kornad. Worn by Hindu ladies; ₹15.

Mixed cotton and silk cloth, called sabai alankaram. Made at Kornad. Worn by Hindu ladies; ₹15.

Mixed cotton and silk cloth, called kiruminchi. Made at Aiyampet. Worn by Muhammadans as trousers; ₹11-8.

Mixed cotton and silk cloth, called Benares. Made at Aiyampet. Worn by Muhammadans as trousers; R14-8.

Silk cloth, called sulídar. Made at Aiyampet. Worn by Muhammadans as trousers; R11-8.

Brocaded silk cloth. Made at Tanjore. Worn by Hindu ladies; R40.

Red, green and violet dyes, and skeins of silk (dyed and undyed) used in manufacture of the above cloths.

In Tanjore the weavers obtain the rough kora silk from Bengal. It is dipped in cold water with chunam (lime) and Fuller's earth, and boiled. After an hour it is taken out, soaked in cold water, and washed. By this means it is bleached. The bleached silk is dyed by dipping it in hot solutions of dyes obtained from Madras.

In the process of bleaching silk for the manufacture of Aiyampet cloths (kuttuni) no chunam is used. The bleached silk is made red by boiling it in water to which kiruminchi (Cochineal), obtained from Bombay, has been added. The red silk when dipped in a solution of indigo becomes violet.

The weavers of Kornad and Kuttalam obtain their dyed silks from Kumbakonum, a town in the Tanjore District.

The following information as to the method of dyeing the cotton, used in the manufacture of cotton and silk cloths, is gathered from the reports of village officers in Kornad and Kuttalum :—

Black dye.—Indigo, obtained from the Chingleput and South Arcot Districts, is put into a pot of water in which *Cassia tora* has been previously boiled, and mixed with chunam. During four days the pot is well shaken, and when the water is clear, the cotton thread previously soaked in pure water is put into, and subsequently dried in the sun. This process is repeated six times. Finally, the thread is soaked in water in which a seer of kasu-katti for every three seers of thread has been boiled.

Red dye.—The cotton thread is first soaked in water mixed with gingelly oil and sheep dung. After a few days it is taken out and placed in water in which the ashes of plantain root and nayurinchi plant have been dissolved. It is next soaked in fresh water and subsequently soaked five or six times in water with which puna (*Morinda umbellata*) powder has been mixed, dried, and, after some days, put into a solution of vembadai (*Ventilago Madraspatana*) bark, and boiled in an oven. It is then washed and dried.

TRICHINOPOLY DISTRICT.

White silk.
Silk dyed green.
" " red.
" " violet.
" " yellow.
Choli made at Ariyalur; R2.
" " " " annas 10.

The silk is purchased from merchants of the Tanjore District, who are said to get it from Mysore. When purchased, the silk is raw and stiff, and is first converted into white silk by boiling it in a solution of soda.

(1.) Red silk.—16 viraganidai of alum, 8 viraganidai of turmeric, 4 seers of lac, and 4 palauns of tamarinds are used for every seer of silk. The alum and turmeric are powdered and mixed with water. The silk is soaked in the mixture for four hours. The lac is powdered, boiling water poured over it, and churned with a heavy wooden roller. The tamarinds are separately soaked in water, and the tamarind-water is mixed with the filtered lac-water. Into this mixture boiling, the silk which has been treated with turmeric and alum is placed, and becomes dyed red.

(2.) Violet silk.—The colour is obtained by soaking the white silk in a solution of violet powder (aniline?).

(3.) Yellow silk.—Turmeric is used instead of the violet powder.

(4.) Black and green silks are not made in this district.

ASSAM.

JORHAT.

Antheræa assama (Muga), and Attacus ricini (eri).

Larvæ in spirit.
Pupæ „
Cocoons.
Thread.
Cloth.

Bamboo trays, by means of which muga larvæ, after the leaves of the trees on which they have been feeding are exhausted, are transferred to another tree.

Plain pat (*Bombyx textor*) silk cloth.
Coloured „ „ „ „
Plain muga and pat mixed „ „
Coloured „ „ „ „ „ „
Plain „ silk cloth.
Coloured „ „
„ „ and pat mixed „ „
Plain „ and cotton „ „ „
„ Eri silk cloth
„ Mezankuri (muga) „ „

CAWNPORE WOOLLEN MILLS, Co.

Tasar tustre serges; width 27 inches.
„ tweeds; width 54 inches.

CASTOR SEED, OIL AND OIL-CAKE.

BENGAL.

Variety.	Specimens sent.
Baidyanáth	Seed.
	Oil, No. 1, and oil-cake.
	„ Good-second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake.
	„ No. 3, and oil-cake.
Bámungámá	Seed.
	Oil, No. 3, and oil-cake.
Birpur	Seed.
Calcutta	Lamp oil, superior quality.
	„ „ inferior „
	Oil from parched seed and cake.
	Wooden mallet used to crush seeds.
	Bamboo winnower used for cleaning seeds.
Chakar	Seed.
Cuttack	„
	Oil, No. 1, and oil-cake.
	„ Good second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake.
	„ No. 3, and oil-cake.
Kahlgaon	As above.
Karat.	Seed.
Khagrai	„
Makaya	„
	Oil, No. 1, and oil-cake.
	„ Good second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake.
	„ No. 3, and oil-cake.
Mathurápur	Seed.
Midnapore	„
	Oil, No. 1, and oil-cake.
	„ Good second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake.
	„ No. 3, and oil-cake.
Monghyr	Seed.
Nakhara	„
Patna.	„
	Oil, No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake.
	„ No. 3, and oil-cake.
Pirpainti	Seed.
	Oil, cold-drawn, and oil-cake.
	„ No. 1, and oil-cake.
	„ Good second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake
	„ No. 3, and oil-cake.

Variety.	Specimens sent.
Rásulpur	Seed.
	Oil, No. 3, and oil-cake.
Rovelganj	Same as above.
Roshra	Seed.
Sahibganj	„ No. 1, and oil-cake.
	Oil, Good second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2, ordinary and oil-cake.
	„ No. 3, and oil-cake.

MADRAS.

Coconada	Seed.
	Oil, cold-drawn, and oil-cake.
	„ No. 1, and oil-cake.
	„ Good second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake.
	„ No. 3, and oil-cake.
Kotapatam	Same as above.
Masulipatam	Seed.
	Oil, Good second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake.
	„ No. 3, and oil-cake.
Salem	Seed.
	Oil, No. 1, and oil-cake.
	„ Good second, and oil-cake.
	„ No. 2, and oil-cake.
	„ No. 2 ordinary, and oil-cake.
	„ No. 3, and oil-cake.

NORTH-WESTERN PROVINCES.

Etawa	Seed.
	Oil, No. 3, and oil-cake.
Jhansi	Oil used in Al dyeing.

EAST INDIAN RAILWAY FACTORY, MANAURI.

Seed.
Oil, cold-drawn.
„ No. 1.
Oil-cake, 2nd quality.

NORTH-WESTERN RAILWAY OIL MILLS, LAHORE.

Seeds cultivated in railway land.
Seeds used in experiments Nos. 1 to 8.
Oils and oil-cakes obtained from above experiments.

LINSEED, LINSEED-OIL AND OIL-CAKE.

BENGAL.

PLACE FROM WHICH OBTAINED.	VARIETY.	SPECIMENS SENT.
Bayda	Bold	Seed, oil and oil-cake.
Bhágalpur	Medium	" " "
Gauripore Mills	Bold	Seed (oil delivered in England).
" "	Small	" " "
Hánskháli	Medium	Seed, oil and oil-cake.
"	Small	" " "
Khagrai	Medium	" " "
"	Small	" " "
Midnapore	Medium	" " "
Patna	Bold	" " "
"	Medium	" " "

BERAR.

Akola	Brown or red	Seed.
Amráoti	"	"
Yeotmal	"	"

CENTRAL PROVINCES.

Hoshangabad	Red	Seed.
"	White	"
Jubbulpore	Red	"
"	White	"
"	Mixed	"
Nagpur	Red	"
"	White	Seed, oil and oil-cake.
"	Mixed	Seed.
Raipur	Red	"
Saugor	"	"

NORTH-WESTERN PROVINCES.

Cawnpore	Bold	Seed, oil and oil-cake.
"	Medium	" " "
Saharanpur		" " "

PANJAB.

Lahore	Red	Seed.

RAJPUTANA.

Alwar	Red	Seed.
Bayana	"	"

Place from which obtained.	Variety.	Specimens sent.
Bhartpur	Red	Seed.
Bikanir	,,	,,
Bundi	,,	,,
,,	White	,,
,,	Mixed	,,
Dholpur	Red	,,
Jaipur	,,	,,
Jhaláwar	,,	,,
Kota	1st quality	,,
,,	2nd ,,	,,
Shahpur	Red	,,
Tonk	,,	,,
,,	White	,,
Udaipur	Red	,,

SESAMUM (TIL OR GINGELLY) SEED, OIL AND OIL-CAKE.

BENGAL.

Place from which obtained.	Variety.	Specimens sent.
Abaipur, Jessore District	Black and white mixed called Chumki	Seed, oil and oil-cake.
Calcutta market	" and white mixed, called Gargará	" " "
Cuttack	Black	" " "
Midnapore	"	" " "
East Bengal	Hard, called Kát til, black and red mixed.	" " "
North Bengal	Ditto	" " "
"	Ditto (crushed)	Seed.
"	Black	" oil and oil-cake.
South Bengal	Hard, black and red mixed	" " "

BERAR.

Akola	White	Seed.
"	Red	"
Amráoti	Black	"
"	White	"
"	Red	"
Yeotmal	White	"
	Red	"

CENTRAL PROVINCES.

Hoshangabad	Black	Seed.
"	White	"
"	Red	"
Jubbulpore	Black	"
"	White	"
"	Red	"
Nagpur	Black	"
"	White	"
"	Red	"
Raipur	Black	"
"	White	"
"	Brown	"
Saugor	Black	"
"	White	"

MADRAS.

Coimbatore	Black	Seed, oil and oil-cake.
Godávari	"	" " "
Tinnevelly	Black and red mixed	" " "
"	White " "	" " "

NORTH-WESTERN PROVINCES.

Place from which obtained.	Variety.	Specimens sent.
Cawnpore	Black	Seed, oil and oil-cake.
„	White	„ „ „
Shaháranpur	„	„ „ „
	Black and white mixed	„ „ „

PANJAB.

Lahore	Black	Seed.
„	White	

RAJPUTANA.

Alwar	Black	Seed.
„	White	„
„	Mixed	„
Bayana	Black	„
Bhartpur	„	„
„	White	„
Bikánir	Mixed	„
Bundi	Pure white	„
„	White	„
„	Black	„
„	Mixed	„
Dholpur	White	„
„	Black and white mixed	„
Jaipur	Black	„
„	White	„
Jhaláwar	Brown and white mixed	„
Jodhpur	Black	„
„	White	„
„	Brown and white mixed	„
Karauli	Black	„
„	White	„
Kishengarh	Black	„
„	White	„
Kota	Black	„
Shahpur	„	„
„	White	„
Tonk	Black	„
„	White	„
„	Rameli	„
Udaipur	Black	„
Wair and Bhusawar	„	„
	White	„

Edgar Thurston,

Offg. Reporter on Economic Products to the Government of India.

IMPERIAL INSTITUTE SERIES.

HAND-BOOKS

OF

COMMERCIAL PRODUCTS.

INDIAN SECTION.

No. 7.

RESIN AND TURPENTINE FROM INDIAN PINES.

Published under the Authority of the Government of India.

CALCUTTA:

OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.

1893.

Price three pence.

PREFACE.

The Government of India have arranged to provide to the Imperial Institute for the illustration of the Economic Products of India—

(A) a descriptive Catalogue or Dictionary;

(B) an index collection of all products;

(C) a commercial collection of special products;

(D) a hand-book descriptive of C.

A.—The descriptive Catalogue has been completed, and is termed the "Dictionary of the Economic Products of India." The compilation has occupied eight years, and has been made under the Editorship of Dr. G. Watt, C.I.E., Reporter on Economic Products to the Government of India. It has been confined to the collation of facts and statistics available up to the date of the publication of the work.

To each product there is assigned in the Dictionary a separate number, which will be permanently maintained for purposes of reference.

B.—The index collection will, when completed, be comprised of small samples of every economic product of India, which will bear the same numbers as those assigned to the products in the Dictionary.

C.—The commercial collections are on a larger scale. The number of products of which a collection is provided each year will be limited to about twenty.

Each collection will comprise as complete a set of specimens of the product in its raw and manufactured state as is necessary for the fulfilment of the object with which the commercial collections and hand-books are provided.

D.—The hand-books will supply, in a separate pamphlet for each product, the information contained in the Dictionary, amplified by supplementary facts and statistics, and illustrated by maps, diagrams, photographs, etc.

The objects of the commercial collections and hand-books which accompany them are—

1. To secure, while each collection is being made for the Institute, a thorough and special investigation in India through which fresh information regarding the product concerned, not contained in the Dictionary, may be obtained.
2. To illustrate the Dictionary in a manner more complete than can be effected by the index collection.
3. In the case of products which are not generally known—
   - (*a*) to bring them to the notice of those interested;
   - (*b*) to indicate the extent to which, and conditions under which they are procurable;
   - (*c*) to ascertain their commercial value;
   - (*d*) to secure, through the Governing Body of the Institute and commercial experts whom they may consult, such special trial or analysis of them as can be more effectually made in England than in India.

E. C. BUCK,

Secy. to the Govt. of India,
Dept. of Revenue and Agriculture.

RESIN AND TURPENTINE

FROM

INDIAN PINES.

In this hand-book the available information as to the extent of pine forests available and manufacture of turpentine on the North-Western Himálaya and in Assam and Burma has been brought together in amplification of a summary of the main facts elicited by enquiries as to the likelihood or possibility of establishing a trade in turpentine between India and England, which was sent to the Secretary of State in 1885.

The chief countries in which resin is obtained, and in which facilities exist for the production of colophany and turpentine, are France and America.

I.—FRANCE.

The manufacture of resinous products from the maritime pine (**P. pinaster**) is carried out on an enormous scale in the departments of the Gironde and Landes. The processes of collecting the resin and manufacture of the products are fully described by M. Croizette Desnoyers in his "Notice sur le gemmage du Pin maritime"* from which the following account is taken:—

1.—Collection of the Resin.

The maritime pine contains very large and abundant resiniferous canals. But, as the resinous juices are much more active in the sap-wood than in the heart-wood, light vertical incisions will expose these canals, and produce a flow of resin. On this principle the extraction of the resinous matter depends.

Towards the end of February or at the beginning of March the operation is started by removing the rough outer bark, so that only the last few layers of bark tissue are left outside the sap-wood. The bark should only be removed over that portion of the trunk which will be resined during the season. An allowance is made of 10 centimetres for the height and 2 to 3 centimetres for the width, this operation having

* Exposition Universelle, Paris, 1878. Ministère de l'agriculture et du commerce, Administration des Forêts.

the following objects: (1) to prevent the débris of the bark from falling into the receiving vessel; (2) to avoid blunting the edge of the cutting instrument and losing resinous matter by the roughness of the bark.

The second operation, which is generally performed from the 1st to the 10th of March, consists in cutting the sap-wood, and consequently the resiniferous canals, with the axe (*abchotte*). The resin tapper commences by making at the foot of the pine an incision, called the cut,* which is convex above, and has a width of 10 centimetres, a height of 3 centimetres, and a depth of 1 centimetre.

The resin oozes out in viscid and transparent droplets, which become inspissated in contact with the air. A portion, called *galipot*,† solidifies, and forms a crust on the cut, and the remainder, which is more liquid, flows into a pot.

Every week, and in the season during which the pines yield abundantly every five days, the cut is refreshed by *piquage, i.e.* the removal of a thin shaving at its upper part, so that it continually increases in height while maintaining a constant or even decreasing length.

In making the *piquage* the resin tapper revives the wound over a length of 10 to 12 centimetres, but takes care—and in this his skill is tested—to remove at each *piquage* only an extremely thin pellicle, so that the wound may be refreshed as frequently as possible without exceeding the depth of 1 centimetre. The *piquage* takes place about 40 to 45 times in the year.

When the pot is sufficiently filled, which occurs every fifteen to twenty days, the resin tapper empties it into a wooden basket, replaces the pot, and transports the contents to big reservoirs called *barcous*, which are made of wood or bricks here and there in the forest.

There are two methods of tapping: tapping to death (*gemmage à mort*) and cautious tapping (*gemmage à vie*).

The former is applied both to pines which have to disappear in the thinnings and to those which have reached the term of exploitation or turn for regeneration. Under these conditions, as the pines have only a short time to live, as much resin as possible is extracted, and several cuts—two to six according to the size of the tree—are made simultaneously.

The latter is only practised on trees which it is desired to preserve for a long time. It is necessary, therefore, to tap them in such a way as not to exhaust them and completely arrest their vegetation. With this in view, only one cut at a time is opened. When the first cut, at the end of five years, has reached the height of 3m. 80, the tree is allowed to rest during several seasons, and, only after this period, a new incision is made, either from 15 to 20 centimetres from the abandoned cut, or on the opposite side of the pine. The operations are carried out in the same manner as in the first instance. In this way a circuit of the tree is made, and the intervals between the old notches are tapped in rotation; and, with these consecutive periods of tapping and rest, not only are the pines resined, but are also kept alive for a long time.

[As regards the methods of tapping and management of the pine in the Dunes of Gascony, Colonel Bailey‡ makes, *inter alia*, the following observations:—

Gemmage à mort is adopted in all thinnings of trees aged 25 years

* The cuts, when left alone, soon heal up by the formation of new rings of wood and bark, and some time after a new cut may be opened in the swelling formed by the bark over the old cut.

† This is scraped off once or twice a year.

‡ *Indian Forester*, February, 1888.

and upwards, and also in the seed felling, as well as in the final felling. The operation is commenced five years before the trees are to be cut down, and is continued for four years. The aim is to take all the resin that the tree can give, leaving it exhausted at the end of the fourth year. One result of this treatment is to cause an abundant growth of seed; and this fact has great importance when the last representatives of the crop are about to be removed, for it ensures the springing up of a full crop of seedlings.

Gemmage à vie.—The trees are not tapped until they have a girth of from 44 to 48 inches, which is usually attained when they are from 30 to 40 years old.

Management of the pines.—The pine has long thin needles giving very light shade, and the trees will not stand being grown close together. Those only which are sufficiently far apart, vigorous, and have a well-developed crown, yield resin in large quantities. Thinnings are commenced when the young trees are from 6 to 8 years old, and are repeated every five or six years. When the forest is 20 years of age, there should be from 250 to 280 stems per acre; but at 30 years not more than 100 to 120 of these should remain, the number being finally reduced to from 60 to 80 when, at the age of 70 or 80 years, regeneration fellings are commenced. With this number on the ground, the upper or cone-bearing branches are free, but not the lower ones. These latter should be allowed to touch, so that the natural pruning of the lowest of them may be effected. In order that the extraction of resin may be successfully carried on, it is necessary that the trees should have clean stems, free of dead branches, up to a height of some 16 feet; and to ensure this it is usual, as an additional precaution, to prune away the lower branches at the time that the first thinnings are made, that is, when the forest is not more than from 6 to 8 years old; but this has to be done carefully, avoiding the removal of too many leaves at a time, as otherwise the growth of the young trees would be checked. It is considered that the introduction of oak (**Q. pedunculata**) beneath the pine would be of great value as a protection to the soil, and as a means of keeping down the undergrowth of grass, gorse, brooms, etc., thus diminishing the risk from fires.

The resin is collected either in a hole scooped out in the sand, or in a glazed earthenware pot.* The first of these systems is very primitive, and possesses inconveniences which do not exist in the other, which is known as the *système Hugues*. The pot is placed beneath the notch from which the resin issues. Each year the resin tapper raises the pot, so that it is at the upper end of the cut worked during the preceding season. It is kept in its place by a nail beneath it, and, when a new cut is worked, the pot is placed on the ground at the foot of the tree.]

2.—Manufacture of Resinous Products.

The resin, as it is placed in the boiler, is made up of a mixture of an essential oil, turpentine, and foreign substances, solid or liquid, resulting from

* To diminish waste, the pot may be covered with a board, which prevents loss of the volatile part of the resin. To get the resin to flow into the pots, a small curved plate of zinc is lightly driven in an oblique direction into the wood immediately over each pot; or a flat plate of zinc with one corner slightly curved upwards is driven in obliquely across the cut, the curved corner being immediately over the pot, which is hung on one side of the cut. When there are irregularities in the stem, or when it does not stand perpendicularly, chips of wood, driven into the wood and ingeniously arranged, guide the resin in the required direction.

prolonged stay in the pots or reservoirs in the forest. Like all essential oils, turpentine is a mixture of an essence called essence of turpentine and a resin called colophany.

Essence of turpentine has a density of 0·85. It is a colourless, sticky liquid, with a characteristic odour, boiling at 157°, and volatilising easily in contact with hot water and steam at 100°. The density of the vapour of the essence is 4·7.

Colophany is a solid amorphous body, of a more or less deep honey-yellow colour, which has a density of 1·08, softens at 70°, melts at 135°, and boils at 200°.

The double principle on which the extraction of the turpentine or its derivatives rests is that:—

1. By liquefaction and filtration of the resin, the turpentine is separated from the water, gas, earth, and wood which are accidentally mixed with it.
2. By distillation of the turpentine, which is an intimate mixture of a solid and liquid with very different boiling points, the essence of turpentine and colophany can be separately collected.

The resin is placed in a boiler, closed by a movable lid, which is heated at the same time by an open fire and by steam circulating in the pipes A, A', A'', A''' [Fig. 1]. After five or six hours the temperature reaches 90°C and the

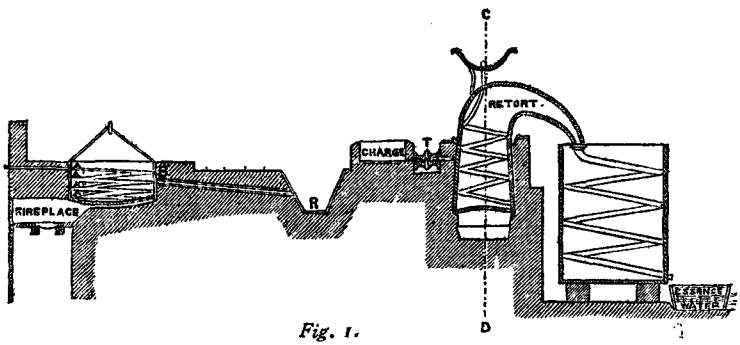

Fig. 1.

liquefaction is complete. At B there is an aperture provided with a grating, and everything which is above this kind of filter flows into the receptacle R. There only remains in the boiler a small quantity of turpentine mixed with foreign substances.

The turpentine is next transported from the receptacle R into a reservoir called the *charge* which measures exactly the quantity which should be introduced, at each operation, by the pipe T into the still.

Pipes pierced by small holes permit the introduction of steam into the retort when the turpentine is at a temperature of 135°C. Effervescence is then produced, and the essence is completely set free. The average charge of the retort is about 300 litres.

At E (Fig. 2) there is an aperture closed by a wooden stopper, which is carefully cemented. When the essence no longer passes into the worm,

the operation is stopped. The colophany flows through the pipe E into a receptacle, and is put into a half cylinder made of very fine metal

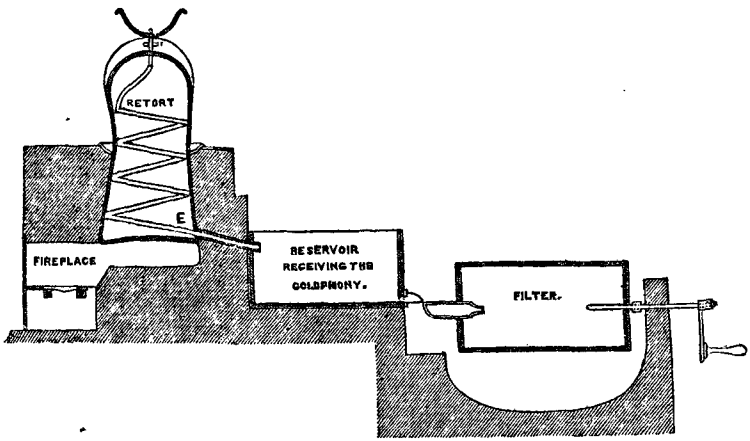

Fig. 2.

gauze which is agitated round its axis. The colophany falls into a reservoir placed beneath the gauze, which retains only the unimportant residue.

The colophany comes out of the retort with a maximum temperature of 130°C, and contains a very fine dust, which mars its transparency, and it has to be filtered through the metallic gauze. It is then put into casks, and may be at once despatched.

The essence which comes out of the condenser, being turbid, is put into earthen jars containing each about 300 litres. The covers are cemented with clay, and the jars allowed to stand for four or five days. The impurities in the essence are deposited at the bottom of the jars. Sometimes copper reservoirs are used, in which the essence can be kept for a longer time, as there is less evaporation.

The quality of the resin varies with the season of its collection, the age of the pines and their vegetation. Further, according as the season advances, the resin is less rich in essence, and, consequently, increases in weight, distillation is more difficult, and greater heat must be applied.

[The process of manufacture of resin, as carried out in a factory which he visited when travelling from Bordeaux to Arcachon is thus described by Colonel Bailey :*—The crude resin, brought to the factory in casks, is, notwithstanding the precautions taken, found to be mixed with a certain quantity of foreign substances, such as earth, chips, bark, leaves, insects, etc. After adding about 20 per cent. of solidified resin (*barras*) scraped from the cuts, it is heated moderately in an open caldron so as to bring it into a liquid state, when the heavier impurities sink to the bottom, and the lighter ones rise to the surface. The liquefied resin, thus obtained, consists of two distinct substances, *viz.* colophany, which is solid at the ordinary temperature of the air, and spirit of turpentine, which is liquid and volatile, and some of which is lost if the caldron is over-heated. These two sub-

* *Loc. cit.*

stances are separated by distillation in the following manner:—The liquid resin is allowed to run through a strainer into a retort, a small quantity of water being introduced at the same time. The rising steam carries the spirit of turpentine with it, and both are, after passing through a refrigerator, caught in a liquid form, in a trough placed to receive them. The spirit, being lighter than the water, lies over it and is easily drawn off. The colophany is then allowed to run out of the retort, and, passing through a sieve, is caught in a vat below. Thence it is poured into flat metal dishes and allowed to harden in the sun, under which process the finer qualities acquire a delicate amber colour. The impure resin left in the caldron is distilled separately, and yields resin and pitch. The spirit of turpentine sells for 24*s.* per 100lb, and the colophany for 9*s.* per 100lb, but the purer kinds, for the manufacture of which only the most liquid portions of the raw resin are put into the caldron, fetch from 13*s.* 6*d.* to 14*s.* 6*d.*, the price of the finest quality, known as Venice turpentine, rising to £4·10*s.* per 100lb.]

3.—Uses of the Resinous Products.

(Essence of turpentine enters into the manufacture of oil paints, varnishes, different kinds of coating and caoutchouc.

Colophany and dry crude resin are used for sizing paper, for obtaining the oils with which vegetable fats and printing ink are made, and for coating the interior of beer barrels. They also enter into the composition of some varnishes and sealing waxes, and are used for bending leaden pipes. Acid colophanies form, with caustic alkalis or alkaline carbonates, salts which possess properties analogous to soaps. These resinous soaps behave exactly like those which proceed from fatty bodies; and, as they absorb atmospheric moisture very readily, they are generally mixed, in varying proportions, with ordinary soaps. The resin, by replacing a portion of the fatty acids, appreciably diminishes the cost.

Galipot enters into the composition of varnishes, and is employed in the dockyards for painting the masts and sides of ships.

The refuse of manufacture of the various products can be burnt in closed chambers to produce lampblack.)

4.—Utilisation of the Wood of Trees which have been tapped.

(In the *Indian Forester*, February, 1888, attention is drawn to the mistaken belief that trees grown for timber cannot be tapped, and Colonel Bailey says:—"The effect of tapping the pine is to cause a flow of resin towards the lower portion of the stem, which thus becomes charged with that substance, and is rendered harder and more durable than the upper portion of the tree. The resinous wood is used for various purposes: very largely for railway sleepers, when it is injected with creosote or sulphate of copper. Planks and scantlings are sent for sale to Paris; while poles, extracted during thinnings, are used as telegraph posts and mine-props. Charcoal is also made in some forests.")

II.—UNITED STATES.

The chief supply of turpentine in the United States is now almost wholly derived from the long-leaved or yellow pine (P. *australis*) of the Southern States.

The method of obtaining the turpentine is described by Mr. F. B. Hough* in the following words:—

"In winter the trees are 'boxed' by cutting a hole in the side, about 3 inches wide, 6 inches deep, and 12 inches long, near the foot of the tree, forming a cavity that will hold about 3 pints. The turpentine begins to flow early in the spring, and continues till towards the end of summer. The incisions are enlarged and extended higher up about once in a week or ten days, and sometimes two or three 'boxes' are cut in the same tree. The crude turpentine is dipped† out of the 'boxes,' and scraped off from the trees from time to time, and now the greater part is distilled near the forests, and the refined products sent from thence to the markets.

"In North Carolina the turpentine is collected about once a month, and 10,000 trees will, in a good season, yield 50 barrels of spirits of turpentine and 200 barrels of rosin. In other regions the trees are cut from twenty to thirty times in a season, and yield from eight to ten dippings. A man will 'chip' from 10,000 to 12,000 boxes in a week as a task. From 1,000 boxes they dip from three to five barrels of 280 pounds each.

"The yield per box in soft turpentine is from ten to twelve pounds, or twenty to twenty-five to the tree of usual size. A barrel of turpentine will yield five gallons of spirits of turpentine, and from sixty-two to sixty-five per cent. of its bulk in rosin. The product of the first year yields a fine light resin, and it grows darker from year to year. A still of forty barrels capacity will distil the crude product of about 350,000 boxes.

"Turpentine is produced to advantage only in warm climates, and in a given place to better advantage in hot and humid seasons than in those that are cold and dry.

"Trees exposed to the air and the sun yield better than those that are crowded and shaded, and those with a well-developed top and well-set with branches much better than those with thin and light foliage."

III.—INDIA.

The question of creating a demand in England for Indian resins and turpentines, the manufacture of which is still in its infancy and requires development, has been before the Government of India since 1881.

In 1885 the following summary of the main facts elicited by enquiries in the North-West Provinces, Panjáb, British Burma, and Assam, as to the likelihood or possibility of establishing a trade in turpentine between India and England, was sent to the Secretary of State:—

1. **Cedrus Deodara** is far too valuable on account of its timber to permit of its being tapped for resin; besides, it only grows in the higher hills, and is thus too far removed from the market. Similarly the high cost of transport from distant forests places both **Abies Webbiana** and **A. Smithiana** out of consideration. The only conifers, therefore, that need be taken into account in connection with the extraction of turpentine for sale are the pines of Assam and Burma, **P. Khasya**, and **P. Merkusii**, and those of the North-Western Himálaya, **P. excelsa** and **P. longifolia.**

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* Elements of Forestry, Cincinnati, 1882.

† Oil of turpentine is distilled from the liquid crude turpentine collected in *boxes* or artificial cavities cut in the trunk of the tree. This liquid substance is technically called *dip*.

2. The area of forests containing trees of **Pinus Khasya** is estimated to be—

		Sq. miles.
Assam		230
British Burma	Tenasserim Circle	40
	Pegu Circle	4
	TOTAL	274

Of the area in Assam, only 33 square miles are at the disposal of Government; the remainder being the property of private persons and subject to 'jhum' cultivation. The forests contain mostly young trees, from which only a very small yield, if any, can be expected at present. The area in British Burma could, with careful fire protection, be largely extended, and the hill-sides transformed into pine forests; but the existing forests are situated at an elevation of from 3,000 to 7,000 feet. They are, moreover, far removed from the market and are inaccessible, so that their management would be expensive. From experiments made it has been ascertained that the cost of crude turpentine obtained from **P. Khasya** amounts to ₹36 per 100lb delivered in Moulmein, and ₹32 for the same quantity brought from the Khasi hills in Assam to Calcutta. The supply at present is very limited, but it could, no doubt, be increased by careful conservative management of the forests.

3. The forests of **P. Merkusii** extend over an area of about 50 square miles in the Thoungyin valley of the Tenasserim Circle. They have been much cut up by taungya cultivation, but successful fire protection would suffice to re-stock the areas, and the forests could be extended without difficulty by propagating the tree. Experiments have shewn that the resin can be extracted without killing the tree, and that a tree of 6 feet girth can yield 12lb at the first tapping. The quantity will decrease in the second and third years, after which the tree will require a lengthy period of rest. The cost of delivery of 100lb of crude turpentine at Moulmein amounts to ₹12. The quantity at present available is small, though it could be largely increased.

4. The areas covered with forests of **P. longifolia** lie in the North-West Provinces and the Panjáb, and are much more extensive than those of the other pines already mentioned, aggregating from 3,000 to 4,000 square miles, including those in Kashmír and other Native States. Most of the forests are very open and exposed to annual conflagrations, but they would rapidly improve with the adoption of a system of fire protection, which is absolutely necessary if they are to be worked for turpentine. Trees measuring between 4 and 6 feet in girth yield from 5 to 6lb at the first tapping, and, unless greatly overtapped, do not die from the process. The yield rapidly decreases however, and only about 10 or 12lb per tree can with safety be obtained every four or five years.

5. It will be observed that, in every case, strict fire protection on a large scale is indispensable to the success of the operations, and this can only be undertaken at present if the extraction of turpentine promises to be a success financially, a contingency which seems very doubtful, as it will hardly be possible to deliver the crude material at any railway station in India under an average cost of from ₹8 to ₹10 per 100lb. The question whether experiments should be continued in the hope of establishing a trade in turpentine between India and England depends entirely on the price which it is likely to fetch in the English market.

1.—**Pinus longifolia** (Chír) and **excelsa** (Kail).

In 1888 a letter was sent by the Government of India to the North-West Provinces on the subject of the necessity for securing a market in Europe for the large quantity of resins and turpentines that Indian pines can yield, but

which remains unutilised. It was considered expedient to lose no opportunity of devising cheap, rapid, and effective methods of tapping and distillation and of the preparation of the numerous secondary products of distillation, and also of studying the conditions under which the trees give their largest yield. The Conservator of Forests, School Circle, was requested to set on foot experiments in connection with **Pinus longifolia** and **excelsa**, and among other points to determine the following :—

(1) The cheapest, quickest, and most effective method of extracting the resin from each kind of tree.
(2) The season of the year at which the work should be done.
(3) The minimum age at which trees should begin to be tapped, when it is not intended to tap them to death (*gemmage à mort*).
(4) The number of years in which tapping to death kills a tree.
(5) The number of years during which a tree, which it is not intended to kill (*gemmage à vie*) can be continuously tapped; also the interval of years after which it may be tapped again, if the operation had to be discontinued in order to give it rest.
(6) The effect of tapping on the timber of the trees.
(7) The most favourable conditions as respects soil, aspect, elevation, gradient, climate, and closeness of leaf canopy under which trees to be tapped should be grown.
(8) Outturn of resin per tree of various sizes and per acre fully stocked.
(9) Distillation of pure oil of turpentine.
(10) Expulsion of all trace of oil from colophany of **Pinus longifolia**.
(11) Preparation of the various secondary products of distillation.

According to the *Indian Forester* (February, 1888) "the aggregate area under **Pinus longifolia** is comprised in the outer Himálayan belt, varying from 20 to 40 miles in width, from Nepál to the North-West frontier. No very approximate figure can be given for the total area lying inside British territory, but it certainly exceeds 2,000 square miles, distributed as follows :—

		Sq. miles.
Kumaon and Garhwal (Sarda to Jumna)		1,000
Jaunsár (Jumna to Tons)		500
Panjáb	not less than	1,000

of which only about 500 are at present workable."

In his working-plan of the Chír Forests Circle,* Jaunsár Division, North-West Provinces, Mr. N. Hearle says with reference to tapping for resin :—"As this is as yet only in an experimental stage and its commercial success is not yet assured, no regular system of working can be laid down here. It will not, however, be necessary, to confine our operations to the Chír areas within 2 miles of the river, but all the Chír forests can be worked for this purpose. Altogether there are probably about 90,000 trees over 2 feet in diameter, and about the same number of second class trees from 18 to 24 inches in diameter which could be tapped. The large mature branchy trees in the compartments which have been felled over could be tapped to death, especially as this will favour the production of seed. The others can be tapped so as not to kill them."

As regards the available quantity of **Pinus excelsa** it is stated in the *Indian Forester* (February, 1888), that about 200 square miles are supposed to exist between the Sarda and the Ganges, and very little between the Jumna and Ganges.

Two methods of tapping the trees for resin may be described, *viz.*, Native and European.

The rough system employed by the hill-men in Kumaon and Garhwal,

* Allahabad, 1889.

described in the *Indian Forester*, 1888, is to cut a sort of niche into the trunk about 3 feet from the ground. The bottom of the niche is hollowed out to receive the resin that trickles down its sides. The resin is collected as the niche fills, sometimes as often as every second or third day, but usually between the fourth and fifth days.

The niche has to be deepened and lengthened from time to time, so as to freshen the wound and keep up the outflow of resin; otherwise the old resin would harden on the sides, and form an impenetrable crust through which no resin could ooze out. The same niche is, as a rule, used for two years and sometimes even for three, when no fires occur in the meanwhile to burn and scorch the resin-incrusted sides. The hill-men seldom concern themselves about the life of the trees they tap, and generally work three niches simultaneously in one tree.

The crude resin obtained by natives of the Himálayas from **Pinus longifolia** is said* to be sold in the bazárs under the name of *biroza, gandha phiroza, dhup, berja, lisa, khalja*, etc.; and a small quantity of turpentine is said to be distilled therefrom for sale in the neighbouring towns.

Systematic tapping operations have been carried on since 1887 in the Chír and Kail forests in Jaunsár by the Forest Department. The following interesting notes on the operations were made by Mr. C. G. Rogers, Instructor at the Forest School, Dehra Dun, during the Jaunsár tour, 1891 :—

"Mr. Moir, the Divisional Officer, told us the following history of the development of the resin works. In 1884, twenty Chír trees were tapped for resin. A nick was cut in the wood of the tree itself, as is done by the natives of Kumaon, and the resin allowed to accumulate in the nick. The dimensions

Fig. 3.

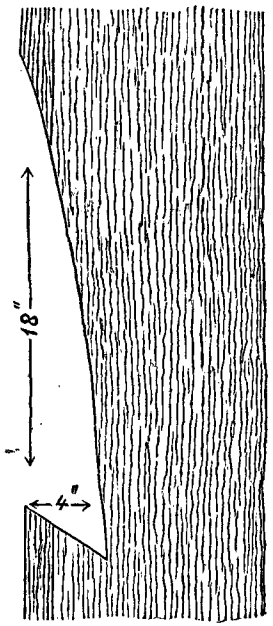

Fig. 4.

* *Indian Forester*, Vol. IX, 1883.

of the cut thus made are shown in Figs. 3 and 4. The trees were tapped from April to November, and the yield was as follows:—

10 trees (Dharmigâd) yielded 30 seers.
„ „ (Chattragâd) „ 36 „

"Resin-tapping works were instituted on a larger scale in 1888. They were of an experimental nature, and, consequently, the cost of the operations was high and the yield of crude resin small.

"1,024 Chír and 501 Kail trees were tapped in the Begúr, Malón, Ninús, and Kathyán blocks, the number of blazes being 2,873, or nearly two per tree. Incisions, 12" long and 6"-9" broad, were made, and the cuts renewed once a fortnight. By the end of November, 1888, they were 24"-30" long.

"Zinc, tin, and unglazed earthenware pots have been tried for catching the resin. The earthenware pots only cost 6 pice, and some of them have lasted three years. An objection to the unglazed pots is that they absorb a large quantity of water during the rains, and, consequently, deteriorate. The pots might, I think, be easily and cheaply glazed with *kanch*, as is done in the case of earthenware vessels made for the Military Department at the Meerut Jail.

"The blazes in the trees were made with the adze (Fig. 5) in common use

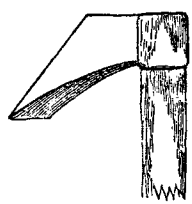

Fig. 5.

in the Jaunsár village. A set of tools sent out from France was tried, but their uses were not thoroughly understood, and, as they were found to be too heavy, they have not been brought into general working.

"The resin was first collected in a haphazard way, but it is now found that one man can look after 500 trees. His work consists of collecting the crude resin, refreshing the cuts when necessary, doing general repairs to the pots, etc. The resin is removed from the pots and packed in old kerosine oil tins. When the tins are full, their mouths are soldered, they are packed in wooden cases, and carried by mules or cattle to Chakráta and thence by cart to Dehra. A tin contains about 20 seers of resin on an average.

"The yield of resin in 1888 was 107 maunds, of which 98 maunds were sent to Dehra for manufacture. The yield between the 15th July and 30th August (when the rainfall is greatest) is very small, indeed in some cases practically nothing.* The cuts are not renewed during that time, and the resin is not collected. During the breaks in the rains, when the weather is warm and the sun strong, the resin flows most freely. The average yield per tree is 2 seers 14⅔ chattaks. Two cuts are usually made in each tree, but, in the case of large trees, as many as ten cuts have been made.

"The total cost of tapping, including cost of tools, pots and distilling apparatus was R1,764, of which R1,006 were expended on tools, pots, etc., and

* Experience both in Jaunsár and in the Panjáb has proved that, although the flow of resin is most active during the season of rest and when the weather is warm and dry, it still continues to ooze out in fair, and sometimes in considerable, abundance throughout the rest of the year. Pots left hanging in winter, under the snow, have been found to have overflowed with resin (*Indian Forester, 1891*).

₹758 on collecting and producing 107 maunds of resin, which makes the cost of production a little under ₹8 per maund.

"In 1889, 1,973 Kail and 3,215 Chír trees were tapped, and yielded 2¾ and 6 seers per tree, respectively. The outturn was 604 maunds of crude resin. The tapping has not yet affected the trees, and, if profitable, the same trees will be tapped for four successive years. The distillation was done at Deoband, and 312 maunds of crude resin were distilled yielding —

Colophany	200 maunds.
Turpentine	42 ,,
Loss of weight (water and dirt)	70 ,,

This gives per maund—

Colophany	26 seers.
Turpentine	5 ,,
Waste	9 ,,

"197 maunds of colophany were sold at ₹4-8 per maund, and 18½ maunds of turpentine at ₹16 per maund, yielding a profit of ₹0-14-9 per maund, excluding capital outlay, or annas 10 per maund net.

"In 1890 the work was continued. 473 Kail and 115 Chír had become exhausted and were abandoned.

"1,540 Kail and 3,100 Chír were again tapped, and the outturn was :—

Chír 286 maunds	or 3·69 seers per tree.
Kail 41 ,,	,, 1·08 ,, ,,

"The tapping still had no effect on the vegetation of the trees tapped.

"A still was set up at Dehra in October 1890.

"Four tanks, two at Kathyán and two at Danichkhera, were made to store the crude resin in. At the former place the walls and bottom are of wood, and at Danichkhera the tanks are of masonry (stone set in lime) and have wooden covers. Before these tanks were used, the resin, when the supply of tins ran short, was stored in vessels made by hollowing out a piece of a stem of a Chír tree. These were furnished with wooden covers, but were not durable and were found to leak.

"The cost of the resin delivered at Chakráta in 1890 was ₹3-2-1 per maund, which was made up as follows :—

	R a. p.	
Cost of collection	1 11 4	per maund.
,, ,, tanks, soldering boxes, etc.	0 12 9	,, ,,
,, ,, carriage to Chakráta	0 10 0	,, ,,

"The stock in the forest at the end of 1890-91 was 293 maunds, of which 220 maunds were afterwards sold at Kathyán at ₹4 per maund, and 20 maunds at ₹4-8 per maund.

"The cost of the collection of resin at Kathyán is—

	R a. p.	
Collection	1 11 4	per maund.
Packing charges	0 12 9	,, ,,
	2 8 1	

"Offers of ₹4 and ₹4-4 per maund have been received for the crude resin without tins or boxes delivered at Kathyán.

"The following is a brief description of the resin works as they are carried on at present : —

"An incision about 1 foot long, 4 inches wide and, at the base, 2 inches deep (leaving out the thickness of the bark, which often reaches a thickness

of 2-3 inches) is made in the tree by means of an adze (*bassula*). A gouge chisel (Fig. 6) is then driven into the tree just at the bottom of the incision

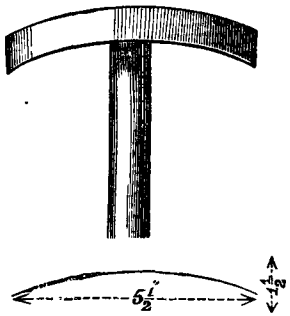

Fig. 6.

made by the adze, thus making a curved cut about 5½ inches long into the tree. Into this a strip of zinc, 5 inches long and 1½ inch wide, is driven by a wooden mallet, and forms a lip from which the resin flows into the pot placed below to receive it. The cuts are renewed,—*i.e.* lengthened and deepened—about twice a month in order to allow the crude resin to flow freely. The length of the cut at the end of the year's work is about 2 feet.

"The cuts on some of the trees which have been tapped for two or three years are only 2-3 feet long and 4 inches deep at the bottom. The incisions

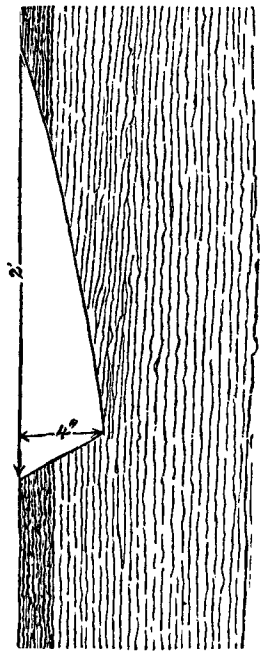

Fig. 7.

made in the trees which are being worked for the first time this year are about 4 inches wide and 1 foot long. The depth of the cuts at the end of the season is about 3-4 inches at the base, decreasing until the top of the incision is reached (Fig. 7).

"The thick bark of the Chír pine is not cut away on either side of the incision, but is left close up to the edges of the blaze (Fig. 9).

"The pot hangs on a nail, and is further secured to the tree by a piece of string passed round it and fastened to a nail driven into the bark on either

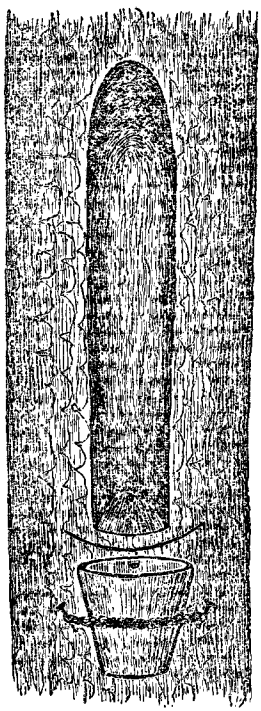

Fig. 8.

side of the pot (Fig. 8). The pot is covered with a piece of bark to prevent evaporation, and dirt from falling into it.

"We observed that only the outermost layers of the sap-wood, immediately beneath the bark, yielded any appreciable quantity of resin. This layer is at the most $\frac{1}{2}$-$\frac{3}{4}$ inch in thickness. This thickness, I think, is more than was observed in the majority of cases, it often being as small as $\frac{1}{4}$ inch. This portion was cut through during the first 3 or 4 inches of the slanting cut, and the resinless layer reached. The resin formed on this portion, and then trickled down over the rest of the blaze into the pot below, being augmented by the resin which came from the same layer of tissues on the sides of the

cut. The exposed portion of the wood deeper than this produced no appreciable quantity of resin. I expect that an appreciable quantity of turpentine evaporates on the way down, and certainly some water must be given off, thus making the resin less fluid and, consequently, checking the flow of resin. In my opinion, as the cuts are at present made, it is only the top 3 or 4 inches and about $\frac{1}{8}$ inch at each side of the cut which yield any appreciable quantity of resin, and the rest of the cut, passing, as it does, through layers of wood in which the quantity of resin is very small, if not practically absent, is useless and harmful. In a freshly cut tree it was observed that the crude resin was flowing from the wood formed during the last four years. Inside the outer corky bark, between it and the wood proper, is a layer of white cortical tissue, the cells of which have not lost their water and food material. This layer soon becomes brown on exposure to the air owing to the formation of cork, and must not be confounded with the wood proper. It is the layer of wood for about $\frac{1}{4}$ inch inside this that gives the principal yield of resin. The effect of not removing the bark on either side of the incision, besides making it much more difficult to take a thin layer of wood off the cut (in freshening it), is that a good many bits of bark fall into the crude resin, collect in the pot, and materially add to the impurities. The crude resin which hardens on the cut is scraped off with an iron spoon, and mixed with the more liquid resin collected in the pot. The rough, scaly portions of the bark should, in my opinion, be removed before the incision is made, leaving the innermost thin brown layer, for a width of at least 4 inches greater than the maximum size the incision is likely to attain over the portions which it is intended to tap during the year. This should be done in February, a short time before the tapping season begins.

"This should cause a decrease in the amount of impurities in the crude resin, more especially the very minute particles of bark, etc., which it is found very hard to separate from the crude resin before it is introduced into the still, and which, becoming burnt in the process of distillation, probably materially darken the colour of the resulting colophany, *i.e.*, account for the darker colour of the Indian colophany as compared with the finer qualities produced in France. By removing the thick bark it will be easier to take off thin layers of wood when refreshening and lengthening the cuts, and the total depth of the cut at the end of the season would be very materially reduced—a most important consideration as far as the healing over of the wounds made in order to obtain resin is concerned. Figure 10 shows how I

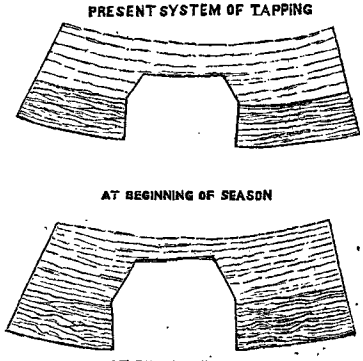

Fig. 9.

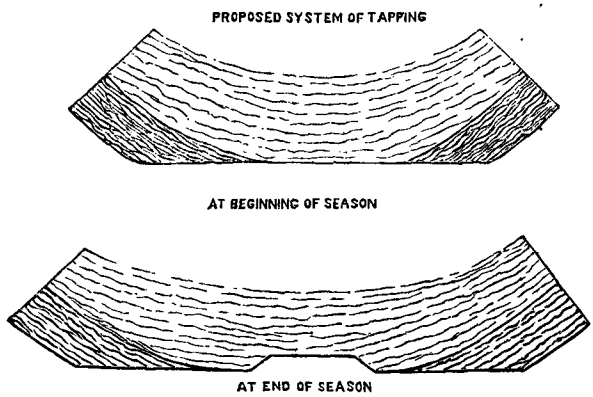

Fig. 10.

propose that the cuts should be made. The total depth of the cuts at the end of the season should not, in my opinion, exceed $\frac{3}{4}$ of an inch. The height might be materially increased. The same incisions might be continued upwards each year, so as to bring a new set of resin ducts into bearing. The pot should be removed to the top of the last year's cut,* and a fresh cut made as before. This point does not seem to have been sufficiently considered so far. The tendency has been to deepen rather than to lengthen the cuts. The trees tapped are large ones, and there is no reason why the cuts should not be at the same time wider, so as to increase the area of the resin-producing areas."

The process of extraction of tar from Chír pine wood at Chattragâdh is thus described by Mr. Rogers :—†

"The tar is separated by subjecting small pieces of Chír pine wood to slow complete combustion in a kiln, through which only a small supply of air is allowed to pass.

"The kiln is made of stones and mud-mortar, the interior being faced with lime, and is egg-shaped inside; its height and also its maximum diameter being 5 feet. It tapers towards the lower end, into which is fixed a perforated iron plate. At the upper end of the kiln is an opening 2 feet in diameter.

"The wood, cut into long strips 1 or 2 feet long and 4 or 6 inches round, is introduced at the upper end of the kiln. The pieces of wood are packed as tight as possible (the closer they are together the better). The upper opening is then closed with a dome of mud-mortar and stones, three holes being left to admit air. The wood is lit from the top, and burns downwards, the rate of burning being regulated by closing or opening the different holes.

* As pointed out by Colonel Bailey (*loc. cit*), this has the great advantage that the resin is not mixed with any large amount of foreign substances, and that, as it runs down the length of a single year's cut only, the loss by evaporation is less than when it was collected at the foot of the tree. When the pot is too high to be reached from the ground, it may be reached with a ladder or removed by a sliding staff, furnished with a pair of metal arms to grasp the pot. And, if a broad-bladed hook-like tool is fixed to the staff, the cuts can be renewed by the workman while standing on the ground.

† Journal of the Hill Tour of the Imperial Forest School, April and May 1891.

"The charge of the kiln is about 15 maunds, and it takes nine days to burn, the volatile products being driven off and charcoal remaining in the kiln.

"Crude tar, organic acids, and water pass through the perforated plate at the bottom, and are collected in tins. Good pitch has been made by driving off the water and organic acids from the crude tar.

"From 15 maunds of wood thus subjected we get 6 maunds of charcoal and 1⅓ maund of crude tar.

"Two new kilns have been recently constructed at Khunigod and Darmigod, and about 80 maunds of tar have been extracted from Chír wood (**P. longifolia**) during the winter. A portion of this has been manufactured into pitch. The cost of manufacture has now been considerably reduced, and at Darmigod has amounted to R2-8 per maund against R3-12 per maund last year at Chatragod. The actual cost of tar delivered at the Chakráta chowky will, therefore, not now exceed R3-8 per maund. The price of coal tar at Chakráta is R10 per maund.

"The tar is at present used for departmental uses, such as for tarring bridges, railings, roofs, etc., for which purposes it is mixed with one-third coal tar, as it is not sufficiently adhesive if used alone, and soon washes. If used in this way, it adheres nearly as long as pure coal tar, with the great advantage that the cost is reduced by about one-half."

The following note on the resin-tapping industry is taken from the Administration Report of the Forest Department, North-West Provinces, 1890-91:—

"This industry promises to become one of great importance in the hills, as numerous enquiries both for crude resin and for the manufactured colophany or resin are being sent. We are offered as much as R4 to R4-4 per maund of crude stuff in Chakráta, and steps have consequently been taken to tap a much greater number of trees in 1891, and improve the style of cut so as to ensure a better flow and less waste. It has already been recorded that 219 maunds of crude resin were worked up at the Forest School in Dehra and converted into 170 maunds of resin and 390 gallons of oil of turpentine. The resin was all sold to the North-West Soap Company at Meerut at R5-8 per maund; but so far the turpentine has not sold well, although those who have tried it, and among them the Deputy Superintendent of the Great Trigonometrical Survey at Dehra, have pronounced favourably on its quality. The Conservator has not the slightest doubt of it eventually finding a very good market. All it wants is to be known, and he will be glad of any assistance the Government can give in bringing it to the notice of Railway and Public Works Department Engineers and other likely customers. What has been sold has been sold at a nominal rate of R2-8 per gallon. The value of the resin and turpentine produced amounted to R1,740, and against this must be set the cost of carriage from Chakráta to Dehra and other expenses, so that the following may be said to be the net revenue under departmental working:—

Departmental Working.

	R	R
Value of rosin and turpentine turned out		1,740
Carriage from Chakráta	114	
Charges in Dehra for distilling, tins, jars, etc.	438	
Ten per cent. of cost of still and other plant, R350	35	
One-fifth of pay of Forest Ranger in charge for five months	50	
		637
Net Revenue		1,103

or, per maund of crude rosin worked up, say R5, which is 12 annas to R1 more than we were offered in Chakráta.

"The cost of collection in the forest of the crude resin and its delivery in Chakráta is R3-2 per maund, so that the profit from the work is on an average R1 per maund under local sales and R1-14 per maund under departmental distillation.

"Another industry which is just starting, and has, the Conservator thinks, a good future is that of the extraction of tar from roots and refuse of the Chír pine and its boiling down into pitch. Last year 90 maunds of this tar, which resembles what is known as 'Burgundy pitch,' were produced and chiefly used locally for tarring the roofs of houses and the timbers of bridges and fences."

A small quantity of crude resin of **Pinus longifolia** was sent, in 1888, to the Anglo-Indian Varnish Company, who reported on it as follows :—

"The crude turpentine had the appearance and consistency of lard. It was put, without any admixture of water, into a copper still with a worm (an ordinary *pot still*), and gently fired. The material that came out was turbid, and had something the appearance of milk. The residue in the still was a white fatty substance with dirt. The proceeds of the first distillation were mixed with water, and subjected to another distillation, or rather rectification.

"From this process we obtained—

(I). Oil of turpentine containing in solution a large quantity of resin.
(II). Oil of turpentine, more or less pure, which was limpid when received from the still, but has since become slightly coloured.
(III). Oil of turpentine containing a very large quantity of naphtha.
(IV). Rosin containing a large quantity of oil of turpentine and naphtha.

"The rosin thus obtained, on being subjected to dry distillation, gave off a considerable quantity of naphtha and the residue (No. V) is a more pure rosin than No. IV, but still contains much oil, which should not be present.

"We made some copal varnish with No. II when limpid, but found the varnish would not dry, and had a peculiar smell.

"This, we must say, has not been a fair trial. We should have got the oil of turpentine much purer, and it is probably owing to this that the varnish does not dry.

"It is the first time we have attempted to distil the raw material, and have no doubt that further trials would lead to much better results."

A sample of oil distilled by Mr. Fernandez at Naini Tal was examined by Messrs. Morrison & Co., who reported that it was good, but a little wanting in strength. The results of its application in cases of rheumatism were stated to be as good as those obtained with French oil.

Specimens of soap prepared, respectively, with 10 per cent. of turpentine and with rosin manufactured at Dehra Dun have been sent by the North-West Soap Company, Meerut, to the Imperial Institute. The soap prepared with the rosin made at Dehra is darker in colour, but otherwise of nearly as good quality as that prepared with American resin. Recent consignments of rosin sent from Dehra Dun to the North-West Company are reported as being of superior quality to the resin previously sent.

The turpentine manufactured at Dehra Dun has been tried by the Bombay-Baroda and Central India Railway, and found to be of good quality and suitable for railway carriage painting. A more extensive trial is to be made with it.

The following notes on the extraction of crude turpentine from Pinus longifolia were prepared by Mr. Lemarchand, Deputy Conservator of Forests, Kangra Division:—

"Experiments were made with reference to the extraction of crude turpentine in 1885 and 1886 with the following results:—

"In March, 1886, 160 Chil trees, with an average girth of from 4 to 6 feet and age from 60 to 90 years, were selected and marked for experimenting on. In April, triangular-shaped niches, 18" long and 6" deep, were cut into each tree. Men were employed to empty the niches as fast as they filled. The exudation of resin was active in April and May, slower in June, and ceased entirely in July.

"The total outturn of crude turpentine from the 160 trees was 7½ maunds, or an average of 30 chittaks per tree.

"The total cost, including wages of carpenters employed in cutting out niches, coolies collecting the resin, earthen vessels for storing the produce, etc., was R19-8-0, or R2-7-6 per maund.

"The method adopted in 1885 was by making a straight flat cut or scar through the bark. Earthen vessels were fixed to catch the turpentine. This method yielded only 13 chittaks per tree—less than half the quantity produced in 1886—and the cost of production (owing to the number of earthen vessels required) was R5-8 per maund, as against R2-7-6 per maund in 1886.

"The trees tapped in 1885 were again tapped in 1886, but yielded only an aggregate outturn of 16 seers of crude turpentine.

"Experiments were also made on trees that had been burnt in previous years during forest fires. These yielded little or no resin.

"It would probably pay to set up a still for the distillation of the crude article on the spot of production, as there is a sufficient quantity available to compete with the American article. The cost of transport to Karachi, and from there to Madras by sea, prevented the possibility of selling the crude material to Messrs. Morrison & Sons, Anglo-Indian Varnish Manufacturing Company, Madras, whose report on specimens sent to them has already been quoted (p. 18).

"The crude material extracted in 1885 and 1886 was sold at an average rate of R4 per maund."

2.—Pinus Khasya.

The following report was made, in 1885, as to the extent to which **P. Khasya** is available in British Burma:—

Pegu Circle.—The area of the forests of **Pinus Khasya** is found on examination to be only about 3 or 4 square miles; but a large proportion of the forest is covered with young growth, which has sprung up on the sites of old taungya grounds. The tree grows plentifully along the Panlaung ridge itself which forms the boundary of the Pegu and Tenasserim circles, but it only spreads over insignificant tracts to the west or within the Pegu Circle. Pine forests are also to be seen beyond Nat-tung, but they have not been examined. The tree is never tapped for turpentine; the wood is used for torches by the villagers in the neighbourhood.

Tenasserim Circle.—The area of the forests of **Pinus Khasya**, which are only found on the higher hills in the Upper Salween District from an elevation of 3,000 to 7,000 feet, is estimated at from 35 to 40 square miles. This area could only be extended by demarcating certain tracts and State Reserves, but this would seriously affect the Karen population, who subsist wholly by taungya cultivation, and for whose maintenance the existing taungya grounds barely suffice. Judging from the position of these pine forests and their great distance from Papun, the highest point up to which the Yoonzaleen river is navigable for small boats, it is considered doubtful whether their resources in turpentine could ever be made available.

In the *Indian Forester* (February, 1888) it is stated that—

"The resin of the Khasya pine is believed to be the most valuable in India, and has attracted the special attention of Sir Joseph Hooker. Forests of this tree are estimated to cover about 270 square miles, of which 230 are in Assam, the remainder being in Burma. Of the area comprised in Assam, only 33 square miles are at the disposal of Government, the rest being in private hands and regularly subject to jhooming, and, therefore, mostly too young at present to be in a condition to yield. The small area in Burma can, however, it is confidently believed, be largely extended and improved, nothing but fire conservancy being required to transform the hillsides into pure pine forests. But the pine localities in both provinces are far removed from markets, and are so little accessible that the cost of 100lb of crude turpentine delivered at Calcutta and Moulmein would, under present conditions, be ₹32 and ₹36, respectively.

"In Burma the Khasya pine is never tapped for resin. The wood is used for torches by the villagers in the neighbourhood of the pine forests."

The following note on the extraction of crude turpentine from the wood of **Pinus Khasya** in the Khasia hills, Assam, is taken from a memorandum by Mr. G. Mann :—*

"In the bazars of the Khasia hills a very resinous wood is sold, which is used by the Natives, as well as by Europeans, for kindling fires, and it is very handy for this purpose.

"This wood is produced artificially in **Pinus Khasya** by cutting a hole in the lower part of the trunk of the tree about one foot above the ground. This hole is usually 9 to 12 inches wide, 6 to 9 inches high and 2 to 3 inches deep. After this hole has been cut, the bark and a little of the wood is removed from a strip about 12 inches wide and 4 feet up the trunk just above the hole, which causes the resinous sap to exude, and all the sap-wood along the strip where the bark has been taken off to become thoroughly saturated with resin within the next 12 months; and it is even said that the wood of the smaller branches in the crown becomes much more resinous in trees thus cut."

For the extraction of liquid turpentine from the wood saturated with resin, the wood is cut into small pieces or chips, and placed in an earthenware cooking pot or vessel till it is full. The mouth of the vessel is closed by tying large, smooth leaves (usually of **Phrynium**) over it; the vessel is turned upside down and placed on a hearth, cut out of the hillside. A gentle fire is then made on or above the vessels holding the wood, and the hot ashes and burning charcoal kept spread over and around the pots to heat them, the consequence of which is that all the turpentine oil exudes from the wood, and drops through the holes made in the leaves into the smaller vessels placed underneath to receive it.

The resinous wood used for the preparation of turpentine sold, in 1882, at the rate of about 80lb for the rupee; and it was stated that sometimes it fetched half as much again, if there was not a very large amount brought to the bazar for sale.

In 1881 Professor H. E. Armstrong, F.R.S., wrote as follows regarding the crude turpentine :—

"It consists of a solid resin similar to colophany, and of a liquid turpentine oil. The latter is remarkably pure and free from smell, and ought, I should say, to be very valuable for purposes for which the French and American oils are used. . . . . Neither French nor American oil, especially the latter, are homogeneous, but this **Pinus Khasya** oil, so far

* *Indian Forester*, Vol. VII, 1881-82.

as I can judge from the examination of the small quantity at my command, is almost a pure substance."

A sample of turpentine oil, the produce of P. **Khasya** from British Burma, was sent to Professor Armstrong who reported* that "this oil is in every respect, so far as I have been able to ascertain, the counterpart of French turpentine, but its optical image; and, if it could be obtained in quantity, would form a most valuable article of commerce."

In 1892, the Conservator of Forests, Eastern Circle, Upper Burma, submitted the following note regarding the distribution and utilisation of **P. Khasya** in Upper Burma and the Shan States:—

"The higher hills on which pines occur have been but little explored, and the information recorded below is consequently incomplete. There are probably large areas of pine forest of which we have at present no knowledge.

"In the Southern Shan States Mr. Jackson reports that pine forests occur both in the drainage area of the Irrawaddy and Salween. They are generally situated at altitudes of 4,000 feet and over, though they occasionally descend as low down as 3,000 feet. They are sometimes found forming pure forests, but are more generally mixed with *ingyin* (**Shorea siamensis**), *thitsi* (**Melanorrhæa usitata**), *tankhyan* (**Terminalia tomentosa**), *panma* (**Schima, sp.**), oaks and chestnuts. The reproduction is invariably good. The trees seldom exceed 6 feet in girth, but east of the Salween, where the largest and best forests are found, trees 9 to 10 feet in girth are not uncommon. The total extent of pine forests in the Southern Shan States is considerable, as there is no State of any size which does not possess some pine-clad hills; but no estimate of area can be given. The most accessible forests are in the Thamakan State on the cart-road from the Meiktila road railway station to Fort Stedman. Pine wood is seldom used for building purposes, as it will not stand the action of rain, but it is sometimes used for interior work ir default of other timber. Where pine forests are found in the neighbourhood of villages, the wood is collected and sold in the bazars for torches. An oblique incision, 1 foot long, is made near the foot of the tree, and the resin which at once exudes is fired. This causes the wood near the wound to become so resinous as to be quite translucent when it is chipped off and used for torches. Under such treatment the trees are sooner or later destroyed by jungle fires, or else become so far cut through as to be unable to support their own weight. Resin or turpentine is never collected in the Shan States or elsewhere in Upper Burma.

In the Mandalay Division there is a tract of pine forest occupying the higher hill tops and slopes over an area of about 150 square miles on the Zawgyi river in the Shan States of Yatsank and Baw between Myogyi and Thondan. The pines, which range up to 10 feet in girth, occur either pure or mixed with the trees above noted. The lower slopes are occupied by *In* forests, but groups of pines have been found so low down as 2,500 feet. The pine forest is generally very thinly stocked, and the ground in the more open parts is covered with tufts of short grass. Reproduction takes place abundantly, but the young seedlings are constantly destroyed by the annual fires. The trees are utilised to a very small extent for torches. Pine forests are also said to occur in Mainglôn, a district of Thibaw, but their extent is at present unknown.

In the Ruby Mines District there are some important groves of pines near Bernardmyo and to the north of Mayôk. In the Bhamo district pines are found on the crests of the hills between the Namyin and Indawgyi rivers.

In the Minbu, Yaw, and Chindwin divisions groups and belts of pines are not infrequent on the tops of the secondary ranges between the Chin hills and the Irrawaddy and Chindwin rivers, and in the Chin hills there are

* Trans. Chem. Soc., 1891.

reported to be extensive areas of pine forest, but only the western spurs have as yet been visited by Forest Officers. In the higher hills the wood is said to be generally used for building purposes. Linear valuation surveys made last year in some outlying pine tracts in the Minbu Division gave the following results :—

Area counted out acres.	Trees 6′ girth and over.	Trees 4½′ to 6′ girth.	Trees 4½′ to 1½′ girth.	Trees below 1½′ girth.
439	337	674	936	1,971

Owing to the generally inaccessible situation of **Pinus Khasya** forests and the high cost of labour, the prospects of establishing a trade in the timber appear very remote, but there is no reason why the forests should not be worked for resin and turpentine, especially in the Shan States, where, in many places, they are mixed with wood-oil (*thitsi*) trees, which are regularly tapped for varnish.

The Conservator proposed carrying out some experiments at Bernardmyo and in the Thamakan State, to ascertain the quantity of resin and turpentine procurable from each tree and the market value of the products.

The following note on the cost of extraction and yield of oil and resin from **Pinus Khasya** in Assam was supplied by the Conservator of Forests, Assam, in February, 1892 :—

"It was estimated by Mr. Mann, in 1884, that to extract the oil in the manner described above cost ₹18-8 per maund of 80℔ or 8 gallons. It would now, owing to higher labour wages, roughly cost nearly 25 per cent. more, or ₹23 per maund, and, delivered at Gauhati on the Brahmaputra, it would cost ₹24-8 per maund.

"Mr. Mann's enquiries led him to calculate that 68℔—or, say, 7 gallons—of turpentine could be obtained from a full-grown tree of 4 feet girth, or one-sixth of the raw material used in the process; that trees should have attained the age of 50 years before being tapped, as the tapping process kills the tree; and that not more than 1,000 gallons yearly could be obtained from the entire area under pine forests in the Khasi and Jaintia hills, provided that these latter were protected. In writing the above it was estimated that about 230 square miles were under pine forest, of which only 33 square miles belonged to Government. The above area has probably been still further curtailed by this date, and, so far as my experience is concerned, the existing forests are not 50 years old. The Government forests about Shillong are still in the pole stage, and are probably under 30 years old. Such forests, therefore, according to Mr. Mann, would be immature for tapping purposes. It seems likely, however, that Mr. Mann indicated the above age as the lowest exploitable one because of the fact that the tree is killed by the process of extraction. In France, I believe, much younger trees are made to yield turpentine, and by methods that do not necessarily kill the tree. It would be interesting to experiment on some of our trees with this object."

3.—Pinus Merkusii.

It is stated in the *Indian Forester*, February, 1882, that "this pine is only found in Burma, where it covers about 50 square miles in the Thaungyin valley in the Tenasserim Circle. These forests are much more accessible than the Khasya pine tracts, and no difficulty is anticipated in extending them by the reservation of suitable tracts, as the population there is sparse

and the tree can be easily propagated. The cost of the **P. Merkusii** resin delivered at Moulmein is the same as that of the Khasya resin, but will be much reduced as soon as the valley is opened up by cart traffic. The few experiments hitherto made seem to show that a tree of 6 feet girth can yield 12lb during the first year in which it is tapped."

In 1885 the following report regarding the turpentine obtainable from **Pinus Merkusii** in British Burma was submitted by the Conservator of Forests, Tenasserim Circle:—

"The area of the forests of this tree in the Thaungyin valley (its habitat) is estimated at about 50 square miles. This area could be extended by propagating the tree over considerable areas in the unreserved forests, and in selected areas within the reserves, where the soil is suitable and where the *In* tree (**Dipterocarpus tuberculatus**) occupies the ground. In fact, there would be no difficulty in doubling the existing area if such means were adopted; and no hardship would be caused to the inhabitants of the surrounding villages if this were done, as the population is sparse in the Thaungyin valley, and the *In* forests, by reason of the poverty of the soil, are not resorted to for purposes of cultivation.

"As regards the cost of collecting the turpentine and delivering it at Moulmein, it has been ascertained that 6 gallons (52lb) of crude turpentine can be obtained from 25 trees in the course of 15 days, at a cost of R6 for hired labour. The cost of transporting these 6 gallons of turpentine from Myawaddi (the source of supply) to Moulmein is estimated at R4-12-0; and the total cost of crude turpentine delivered at Moulmein may, therefore, be estimated at R10-12-0, or R1-13-0 per gallon. Refined turpentine is sold in the Moulmein bazar for about R1-13-0 per gallon, the same rate as crude turpentine could be delivered at Moulmein.

"It is said that, if the turpentine were collected by the Karens and Shans of the Thaungyin valley during their leisure hours (in the same way that forest produce of all kinds is usually collected by them), the actual cost of its collection will be much less (probably by one-half) than the cost of collection by hired labour. It is also expected that, when cart traffic is established between Myawaddi and Kawkareit (*en route* to Moulmein), crude turpentine might eventually be delivered at from 14 annas to R1 per gallon.

"Experiments show that **Pinus Merkusii** can be tapped for turpentine without killing the tree, and that a tree 6 feet in girth will yield 12lb of turpentine in an ordinary dry season of three months. No information is available as to the average quantity of turpentine which could be obtained from a full grown tree. It is not until a girth of 3 feet has been attained that the tree secretes any appreciable quantity of turpentine. The yield of trees 1 foot and 2 feet in girth has been ascertained to be respectively 8⅝ oz. and 1lb 7⅝ oz. in an ordinary season lasting three months.

"As to the total quantity of crude turpentine likely to be available, if circumstances were such as to admit of its remunerative extraction, no definite information is yet available. To ascertain this, it would be necessary to take up a sample area of about 50 acres, and subject only full-sized and larger trees to the tapping process, in accordance with the system in vogue in the forests of Europe. Moreover, the information thus obtained would have to be supplemented by surveys in order to ascertain the average number of trees suitable for tapping purposes per acre, and the precise areas on which tapping operations could be profitably conducted."

In May, 1881, a sample cask of (what was said to have been) turpentine of **Pinus Khasya** was sent to the India Office. In a letter from the Chief Commissioner of Burma, in 1885, however, a belief is expressed that the turpentine then sent was that of **Pinus Merkusii** from the Thaungyin valley.

NOTE ON TURPENTINE.

American turpentine is imported into India from England; French or other turpentine is not known in the Calcutta market.

The turpentine generally sold in the Calcutta market is impure. It is largely adulterated in England with kerosene oil, naphtha, benzoin, etc., and a further adulteration takes place in India. There is very little demand for pure unadulterated turpentine. Purchasers do not look so much for quality as for quantity. Merchants, therefore, keep only small quantities of pure turpentine, which they import direct from America, not through England.

The points of good turpentine are that it is as clear and transparent as glass; that the odour is neither very strong nor bad; that it dries quickly; that, if sprinkled on white paper, it dries at once, leaving no marks behind; and that, when handled, it forms a coating of very fine white dust on the hand. All these properties depend largely on the method of distillation. Any defect in the distillation lowers the quality of the oil. If any attempt is made to introduce the Indian product into the market, the greatest care should be taken in its distillation. Its resemblance to the oil already existing in the market is of far greater importance than its purity. In point of fact, its purity must be destroyed before it is put into the market, and its resemblance to the American oil is the main object which should be kept in view. The Calcutta merchant, from whom the present information was obtained, stated that, on one occasion, a sailor brought to Calcutta a large quantity of pure turpentine which he offered for sale, but that he had great difficulty in disposing of it, because its odour was somewhat different from that of the oil usually sold in the market. It was at length purchased by Messrs. Dykes & Co., the coach-builders.

For internal administration medicinally, pure turpentine is required, but consumers generally buy it from shops for external application, and demand a large quantity for their half-anna or anna. In such cases, they are supplied with stuff very largely adulterated with kerosene oil.

It is estimated that the annual consumption of turpentine in Calcutta is from 10 to 20,000 gallons.

Turpentine is shipped from America to England in tin canisters packed in wooden cases, but it is sent from England to India in iron drums tinned inside, as contact with the iron would discolour the oil.

At the present time the wholesale price of turpentine ranges from R1-12 to R2-9 per gallon in Calcutta.

In the London market the following are recent values of the various turpentines imported, as well as of rosin :—

American turpentine	25/3 per cwt.
„ *rosin* (common)	4/6 „
French turpentine	none.*
„ *rosin*	none.*
Russian turpentine	19/ and 19/6 per cwt.

American turpentine—

Average values, 1891.

January	29/ and 29/9	July	27/3 and 28/9
February	28/6 and 29/3	August	27/3 and 28/
March	28/9 and 29/3	September	27/9 and 28/6
April	29/ and 30/3	October	27/ and 28/
May	29/3 and 30/3	November	26/ and 26/9
June	28/9 and 29/3	December	25/3 and 26/

* French rosin or turpentine seldom or never comes upon this market now, so that there is no means of recording prices or averages.

American Rosin—

Average values, 1891.

Common strained.

January	4/9	July	4/4½
February	5/	August	4/4½
March	4/9	September	4/—
April	4/9	October	4/6
May	4/7½	November	5/
June	4/6	December	5/

The Dehra turpentine is of very superior quality, but cannot at present be sold at the highest price obtained for the best imported turpentine. It can be sold in Calcutta at R1-8 to R1-14 per gallon, and, if it became established in the market, could probably be sold at R2 to R2-4 per gallon.

The Dehra turpentine cannot, however, aspire to conquer the Calcutta market, which is too far away and requires too much; all it can hope to do is to obtain a good sale in Upper India. Messrs. Lyell & Co. of Allahabad are advertising turpentine at R4-8 per gallon. If the Forest Department could get R3 per gallon, all round, for Dehra turpentine, it would be worth while to build a factory and manufacture it and rosin (which fetches now R5-8 per maund) wholesale.

EDGAR THURSTON,

Offg. Reporter on Economic Products to the Government of India.

G.I. C. P. O.—No. 24 R. & A.—8-5-93.—1,500.

IMPERIAL INSTITUTE SERIES.

HAND-BOOKS

OF

COMMERCIAL PRODUCTS.

INDIAN SECTION.

No. 13.

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PREFACE.

The Government of India have arranged to provide to the Imperial Institute, for the illustration of the Economic Products of India—

(A) a descriptive Catalogue or Dictionary;

(B) an index collection of all products;

(C) a commercial collection of special products;

(D) a hand-book descriptive of C.

A.—The descriptive Catalogue has been completed, and is termed the "Dictionary of the Economic Products of India." The compilation has occupied eight years, and has been made under the Editorship of Dr. G. Watt, C.I.E., Reporter on Economic Products to the Government of India. It has been confined to the collation of facts and statistics available up to the date of the publication of the work.

To each product there is assigned in the Dictionary a separate number, which will be permanently maintained for purposes of reference.

B.—The index collection will, when completed, be comprised of small samples of every economic product of India, which will bear the same numbers as those assigned to the products in the Dictionary.

C.—The commercial collections are on a larger scale. The number of products of which a collection is provided each year will be limited to about twenty.

Each collection will comprise as complete a set of specimens of the product in its raw and manufactured state as is necessary for the fulfilment of the object with which the commercial collections and hand-books are provided.

D.—The hand-books will supply, in a separate pamphlet for each product, the information contained in the Dictionary, amplified by supplementary facts and statistics and illustrated by maps, diagrams, photographs, etc.

The objects of the commercial collections and hand-books which accompany them are:—

1. To secure, while each collection is being made for the Institute, a throughout and special investigation in India through which fresh information regarding the product concerned, not contained in the Dictionary, may be obtained.
2. To illustrate the Dictionary in a manner more complete than can be effected by the index collection.
3. In the case of products which are not generally known—
   - (*a*) to bring them to the notice of those interested;
   - (*b*) to indicate the extent to which and conditions under which they are procurable;
   - (*c*) to ascertain their commercial value;
   - (*d*) to secure, through the Governing Body of the Institute and commercial experts whom they may consult, such special trial or analysis of them as can be more effectually made in England than in India.

E. C. BUCK,

Secy. to the Govt. of India,
Dept. of Revenue and Agriculture.

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[This product is described in Dr. Watt's Dictionary of Economic Products, Vol. I, A. 137—197.]

CUTCH.

In this hand-book the article in the Dictionary of Economic Products, by Dr. G. Watt has been considerably modified by the incorporation of information derived from reports specially called for in connection with the collections made for the Imperial Institute. Its object is to specially draw attention to the cutch industry in Burma, the process of manufacture, and the present extent and future prospects of the trade.

Vernacular.—*Kat* or *kath, katthá*, HINDUSTANI; *Khayer*, BENGALI; *Kát*, MARATHI; *Kátho*, GUZERÁT; *Káshu-katta, káshu*, TAMIL; *Katti, káshi-katti*, MALAYÁLIM; *Kachu*, KANARESE; *Kaipu*, SINGHALESE.

HISTORY.

At the present day, by far the most important product of *Acacia Catechu* is the resinous extract (Catechu) obtained by boiling down a decoction obtained from chips of the heart-wood.* The practice of preparing this extract has been handed down from remote periods. The Sanscrit authors mention the drug, and Barbosa, in his description of the East Indies published in 1514, mentions what is, in all probability, this drug under the name *Cacho*. He states that it was at that time exported from Cambay to Malacca. *Cacho* is apparently the Kanarese word *Káchu* now applied to it. It is, in fact, probable that the word Catechu is a modern Latin derivative from the South Indian name, and that from South India the product was first exported. Some authors, however, say that it is, derived from the Cochin Chinese word *Caycau*. One of the Tamil names for the plant is *Kati, Kuti*, or *Cate*, and the second half of the word may have been derived from *Chuara* "to drop or distil." Whatever may be the origin of the word catechu, it would save much ambiguity if it could be restricted to the extract from *Acacia Catechu* instead of being made popularly to include one or two other substances, such as gambier, a word of Malayan origin signifying "bitter," and applied to a purely Malayan product (*Uncaria Gambier*). It is quite true that both these astringents contain the same chemical properties, but they are obtained from widely different plants and manufactured in countries separated from each other. In our *Trade and Navigation Returns* the exportation used to appear as 'Cutch and Gambier,' from which one would naturally infer that both cutch (or catechu) and gambier were exported from India, the relative proportions of which had not been determined. I am informed, however, by my friend Mr. J. E. O'Conor that this practice was a remnant of the time when the Straits Settlements returns were published with those of India.

In the Kew Bulletin of Miscellaneous Information, February, 1891, it is stated that "gambier must not be confounded with a substance manufactured in India from an entirely different source, namely, the wood of two species of *Acacia*, *A. Catechu*, and *A. Suma*. This is called *Cutch*, or *Black Catechu*. Its composition is very similar, however, to that of gambier.

"The latter, when met with in commerce, is an earthy-looking light brown substance, consisting of cubes about an inch each side, more or less agglutinated. Cutch, on the other hand, is met with in dark brown masses, hard and brittle on the surface and at first softer within. It breaks easily when dry with a shining granular fracture.

"It is, however, curious that there is a form of cutch which a good deal approximates to gambier. This is called *Pale Cutch*.

"From the time Barbosa wrote in 1514 we have no further mention of this substance till 1574, when Garcia de Orta gave a complete account of the plant and the process of preparation of the extract, describing it under its Tamil name *Cate* (*kati* or *kuti*). It was not, however, until the seventeenth century that catechu attracted the attention of Europe. It was then supposed to be a natural earth, and as it reached Europe by way of Japan (being simply re-exported from that island) it received the name of Terra Japonica. At this period, or shortly after, gambier also found its way to Europe, and was, indiscriminately with catechu, called Terra Japonica. Cleyer exploded the mineral notion regarding Catechu, and in 1685 republished Garcia de Orta's account of the preparation of the extract, and declared it to be of Indian origin, the best quality coming from Pegu and other sorts from Surat, Malabar, Bengal and Ceylon.

"Catechu (from *Acacia Catechu*) was received as an officinal drug into the *London Pharmacopœia* of 1721. It was officinal in the *British Pharmacopœia* of 1864, but has since been discarded and Gambier retained, both in Great Britain and India, as the officinal form of the drug Catechu. In the *United States Pharmacopœia* catechu (from *A. Catechu*) is retained, however, as officinal and Gambier discarded."

INTERESTING ETHNOLOGICAL FACTS CONNECTED WITH THE CATECHU INDUSTRY.

"Before passing to discuss the chemical properties and modes of preparation of cutch (kutch) and kath, the digression may be regarded as not altogether inappropriate to say something of the race of people who, from time immemorial, have made it their sole occupation to prepare this extract. A brief history of this nature it is thought may help to throw some light upon questions connected with the early history of the drug, and may prove interesting to those who have not the opportunity of consulting the voluminous gazetteers and official records from which it is extracted. In his *Himálayan Districts* (which constitutes Vol. X of North-Western Provinces Gazetteer) Mr. Atkinson says: 'The men employed are of the *Dom* caste, and are called *khairis*, from the vernacular name of the tree.'

"In the *Bombay Gazetteer*, Vol. XIII, an interesting account of the *kathkaris* is given, of which the following synopsis contains the most

interesting features. It is stated that the *kathkaris*, or makers, are believed to have entered the district of Thana from the north and to have settled in the *Gujerát Athávisi*, the present district of Surat. According to their story, they are descended from the monkeys which the god *Ram* took with him in his expedition against the demon-king of Ceylon. They are darker and slimmer than other forest tribes. They have a peculiar language of their own, but in conversation they have a tendency to reduce words and shorten speech, and uniformly endeavour to get rid of the personal, not the tense, inflections of the verbs. The women are strong and healthy, and pass through child-birth with little trouble or pain. They are said sometimes when at work in the fields during the rains, to retire behind a rice-bank and give birth to a child, and after washing it in the cold water, to put it under a teak-leaf rain-shade and go back to work. They are divided into two sections—*Sbus* or *Marathas* and *Dhors*. The former do not eat cow's flesh, and are accordingly allowed to draw water from the village well. They are also more or less a settled tribe. Some of them still make *kath* or catechu, but from the increase of forest conservancy the manufacture is nearly confined to private *inám* villages and to forests in Native States. When they go to the forests to make catechu, they hold their encampment sacred, and let no one come near without giving warning. Before they begin their wood-cutting, they choose a tree, smear it with red-lead, offer it a cocoanut, and bowing before it ask it to bless their work. The catechu is made by boiling the heart-juice of the *khair* tree, straining the water, and letting the juice harden into cakes. The *kathkaris* will never go in for regular cultivation; they eat rats and monkeys, and live chiefly upon jungle produce, or by theft, stealing from fields and barns.

"In the tenth volume of the *Bombay Gazetteer*, p. 48, it is further stated that the '*kathkaris*, a wild forest tribe in the Ratnagiri District, who subsist entirely by hunting, now that their more legitimate occupation of preparing catechu, *kath*, has been interfered with, habitually kill and eat monkeys, shooting them with bows and arrows. In order to approach within range, they are obliged to have recourse to stratagem, as the monkeys at once recognise them in their ordinary costume. The ruse usually adopted is for one of the best shots to put on a woman's robe (*sári*) under the ample folds of which he conceals his murderous weapons. Approaching the tree on which the monkeys are seated, the disguised *shikari* affects the utmost unconcern, and busies himself with the innocent occupation of picking up twigs and leaves. Thus disarming suspicion, he is enabled to get a sufficiently close shot to render success a certainty.'

"In the villages of Navágám, about 7 miles north-east, Gangadia, 11 miles south, and Nelsa, about 9 miles south-west of Dohad, every year on the day after *Holi* (April) a ceremony called the *chul* or 'hearth' takes place. In a trench 7 feet by 3 and about 3 deep, *kher* (*Mimosa Catechu*) logs are carefully and closely packed till they about 2 feet above ground. The pile is then set on burn to the level of the ground. The village reaks a cocoanut, kills a couple of fowls, and the pile. Then, after washing their feet, dman walk barefoot hurriedly across

the fire. After strangers come to fulfil vows, and giving one anna and a half cocoanut to the sweeper and the other half cocoanut to the headman, wash their feet, and, turning to the left, walk ovr the pile; the fire seems to cause none of them any pain." (*Bombay Gazetteer, III, 310.*) At the village of Chosala, about 7 miles north of Dohad, a stream runs into a cave, and on this spot an image of *Mahadev*, under the name of *Kedáreshvar*, has been set up. The place is sacred to the Bhils.

"Many other similar ceremonies and sacred practices might be mentioned, showing that the preparation of catechu dates back to the remotest antiquity. The tree is sacred to *Mangala* or *Karttikeya*, one of the Hosts of Heaven. It receives special worship, and is often mentioned in the Vedas."

CHEMICAL COMPOSITION.

"Catechu contains a variety of tannic acid called mimotannic acid which is soluble in water, and *catechu* or catechuic acid, which is insoluble. Mimotannic acid differs from tannic acid in yielding a greenish-grey precipitate with ferric chloride, and by not producing pyrogallic acid when heated. The destructive distillation of cutch yields pyrocatechin. Quercetine is stated to be contained in cuteh. This principle is the yellow crystallizable substance to which the bark of *Quercus tinctoria*, Oliver, owes its colour. (*Dr. C. T. Hislop Warden.*)

"The chemistry of the catechus has occupied the attention of chemists for some time back, but as yet the views and conclusions arrived at are somewhat conflicting, and the subject may be regarded as still involved in considerable obscurity. The brief chemical note (above) which Dr. Warden has supplied, may be regarded as an abstract of all that is known. In his *Science Papers* D. Hanbury suggests that the process by which the various kinds of cutch, catechu, and gambier are obtained should be carefully studied by persons who have the opportunity of doing so on the spot, that the trees yielding each of the forms of these substances should be accurately recorded; for, he adds, 'we wish to identify the trees with the respective extracts.' It would seem that our ignorance upon these important points may have much to do with the conflicting chemical results which at present exist regarding the composition of cutch. There are at least two, if not three, distinct products obtained from each of the cutch-yielding trees, and it is just probable these may have been experimented upon indiscriminately by the chemists of Europe. It would be but in keeping with other instances of two or more species (still more so of members of different natural orders), yielding approximately the same product, to find that the trees which afford the cutch of commerce produce substances chemically dissimilar. Some such ex[illegible] be found in the future to account for a certain numb[illegible] opinions which at present exist regarding the [illegible] cutch and its derivatives. A similar exam[illegible] fact that *Aconitum Napellus* yields a [illegible]

although both species have hitherto been used in the preparation Aconitia.

"'Pegu catechu, when immersed in cold water, turns whitish, softens, and disintegrates, a small portion of it dissolving and forming a deep-brown solution. The insoluble part is Catechu in minute acicular crystals.' (*Flück. and Hanb., Pharmacog.*, 243.) When the crude cutch of commerce is subjected to a dry heat of 100°, or 100° in an atmosphere of hydrogen, it fuses and becomes transparent, losing 4 to 5 per cent. of its weight. It melts at 140° without further loss of water. On ignition there is left 3 to 4 per cent. of ash. If pure it should be completely soluble in boiling hot water, the solution precipitating the insoluble crystals of catechuic acid on cooling. Ether extracts from cutch its catechu or catechuic acid, so that by precipitation from a hot solution, or by means of ether, this substance may be separated for chemical or industrial purposes.

"In addition to catechin, cutch contains, however, other two substances, *viz.* mimotannic acid and a gummy extractive principle. Mimotannic acid is soluble in cold water, and by simple maceration may therefore be removed from cutch. The solution will be observed to be of a thick chocolate colour. If heated to the boiling point it is rendered quite transparent, becoming turbid on cooling. With this solution ferric chloride gives a dark-green precipitate, which will immediately change into purple on the addition of cold-water, or of an alkali.

"Catechuic and mimotannic acids are present in cutch in about equal proportions. The effect of heat upon cutch and its compounds is most important, and, as pointed out by Etti, the chemical changes effected by heat afford the most likely explanation of the discordance of authors as to the formula for catechin. According to Liebermann, confirmed by Etti's re-examination of the substance, the formula for catechuic acid or catechin is $C_{18}H_{18}O_8$. If a piece of cutch be first heated in a crucible and then macerated, it will be found to be completely soluble in cold water. This is explained by Etti as due to the formation of soluble anhydrides from catechin, thus:

$$2\,(C_{18}H_{18}O_8) = 2H_2O + C_{36}H_{32}O_{14}.$$

"The compound thus produced is known as catechutannic acid, and is completely soluble in cold water. By a further loss of water at 190°—200° this becomes $C_{36}H_{30}O_{13}$. Under the influence of heat the anhydride that is first formed is $C_{36}H_{34}O_{15}$, an insoluble, brownish red, amorphous powder, a substance soluble in alcohol and precipitated in crystals by lime-water. These compounds, if formed, in varying proportions, in a piece of catechu, would greatly tend to produce conflicting chemical formulæ in the results of different experiments, and a piece of catechu, which is found to be completely soluble in cold water, should be regarded as inferior in quality (injured through heat) and most probably adulterated by the trader.

"For some time Gautier regarded the catechin of Gambier as quite distinct from that obtained from catechu, but in his more recent publications, he admits them as identical. He now corrects his formula, $C_{19}H_{18}O_8$ which he published as expressing catechin (adopted in

Flück and Hanb., Pharmacog.), into $C_{19}H_{20}O_8$ and suggests for this compound the name of Methyl catechin.

"The soluble catechu-tannic compounds constitute the active astringent principle of the drug, and the tanning and dyeing property for which it justly holds so high a position for industrial purposes.

"*Preparation of pure catechin.*—Etti directs that catechu should be dissolved in about eight times its own weight of boiling water, and the liquid, after being strained through a cloth, should be set aside for some days until the insoluble catechin subsides. This should then be collected and placed under a screw-press, being thereafter dissolved in a sufficient amount of dilute alcohol and the filtered solution shaken up in ether. The ether is next removed by distillation, and the crystals obtained washed repeatedly in pure distilled cold water. It is then found to exist in the form of almost colourless crystals." (*Dict. Econ. Products of India, pp. 36-38.*)

ORMS OF THE CATECHU EXTRACT.

There are three substances, all very similar in chemical composition, derived from *Acacia Catechu, viz.* dark catechu or cutch; Indian pale catechu or kath; keersal.

1. Dark catechu or cutch, which is used for industrial purposes, is made into great masses surrounded by leaves, balls, cubes or irregular-shaped pieces, or broken into small blocks. In colour it is externally of a rusty brown, internally of a dirty orange to dark liver colour, in some cases almost black, in others port-wine coloured. It is inodorous, with an astringent bitter taste, followed by a sense of sweetness. It is brittle, and breaks with a more or less resinous and shining fracture.

2. Pale catechu or kath is a grey-coloured crystalline substance, which, under the microscope, is seen to be made up of agglutinated masses of needle-shaped crystals. As sold in the bazárs it occurs either in irregular pieces or in square blocks similar to the dark orange-drown cubes of catechu. This is the substance eaten by natives in their *pán*, which imparts with lime the red colour to the lips and teeth. Continued use blackens the teeth.

3. Keersal is a pale crystalline substance obtained from cavities in the wood of *Acacia Catechu*, where it "occurs in small irregular fragments like little bits of very pale catechu mixed with chips of reddish wood." (*Dymock.*) It is much valued in medicine by the Hindus, and fetches a high price.

In the Calcutta market, in addition to gambier imported from Singapore, three sorts of catechu are known, *viz.* Janakpuri, Telá and Burma or Pegu. Of each of these there are different qualities which vary in price.

Janakpuri (pale Catechu) is brought to Calcutta from Patna. A small quantity also comes from Cawnpore, but the product of the North-Western Provinces is almost entirely used for internal consumption and for export to the Panjáb, Berars, and Bombay. The price of Janakpuri varies from R12 to R20 per cwt. It and gambier are considered best for chewing with *pán*.

Telá (dark Catechu) is also brought to Calcutta from Patna, and is either sold in the crude state or refined. Of telá there are two varieties, called telá proper and mansárámi, of which the latter is the better quality. In the refining process the catechu is first dissolved in cold water, the solution evaporated by boiling, and the residue cast into two shapes, round or belguti (from *Bél*, the fruit of *Ægle Marmelos*, which it resembles), and square, called Chaṭṭká or Kálaġarán. The price of telá varies from ₹7 to ₹10 per cwt.

Neither Janakpuri nor Telá is exported to foreign countries.

Two kinds of Burma catechu are imported into Calcutta, *viz.* the dry and the soft. The present price of soft catechu is ₹12 per cwt., and of dry catechu from ₹22 to ₹28 per cwt.

Bombay cutch is said, in the *United States Dispensatory*, 15th Ed., to yield a higher percentage of tannin than Bengal cutch, but it is commercially almost unknown outside the Presidency. Birdwood describes four forms of it:—

(1) Kaṭchú of Dharwar, flat, round cakes, 2 inches in diameter and one inch thick; dark-brown in colour, and preserved in bajrí husks.

(2) South Konkan, covered with paddy husks.

(3) Khándesh, in angular grains, pale earthy brown internally, darker externally.

(4) Surat, in irregular lumps from the size of a hazel-nut to a walnut.

Madras cutch is said to be, in all probability, the product of *Arecæ Catechu* (the Betel-nut Palm). Dr. Moodeen Sheriff states that the natives of Madras do not know that *Acacia Catechu* yields cutch, although the tree is common in the Presidency.

SELECTION OF TREES FOR FELLING.

In a recent note on cutch manufacture in Burma Mr. Corbett, Deputy Conservator of Forests, says that in places where trees are scarce they are taken as they come, but that, if they are at all plentiful, the cutch manufacturer is fastidious in his choice, making an incision into the heart-wood before felling, so as to determine whether or no the wood is spotted or whether it contains ugyi (the Burman name for keersal), as he knows full well that wood containing this turns out hard cutch, or, as he expresses, that the presence of ugyi makes the cutch sleep; and, as hard cutch always fetches a higher price in the market than soft, the presence of ugyi is a point of primary importance, and trees without spots are rejected if there is a sufficiency of trees with spots.

"The presence of ugyi," Mr. Slave writes, "is one of the principal elements of success in cutch-boiling. From trees rich in ugyi, Sha-ma (hard cutch) may be obtained all the year round; hence a cutch-boiler is always on the look-out for them. He professes to be able to discover them at a distance, as he says that they have a rugged, light-grey bark,

like the tamarind, and are usually found on high ground. Having discovered a tree which he supposes to contain ugyi, he blazes it to the heart-wood on two sides. At first the ugyi are not discernible, but after seven or eight hours they begin to appear, and, when the cutch-boiler re-visits his blazes on the following morning, they are quite apparent. If a dead tree be blazed in a similar manner, the ugyi, if present, are apparent at once.

"According to the position of the ugyi in the section of the tree, the woods are classed by the cutch-boilers as follows:—

I.—Tè-lon-bya, *i.e.* all over the section.
II.—Pat-yan, *i.e.* in a circle.
III.—Swè-bauk, *i.e* on one side only.

"Ugyi are mostly found in Sha-ni (red), seldom in Sha-wa (yellow), and never in Sha-net (black) or Sha-bya (blue) catechu trees; always in the heartwood, never in the sap-wood.

"Noticing the effect of these ugyi on the cutch, and believing that the addition of a few handfuls of lime would serve the purpose equally well, the cutch brokers some years ago ordered their agents to try the experiment. The soft cutch certainly turned out hard, but the lime was immediately detected by the merchants, and the cutch could not be disposed of at any price. This seems rather absurd, as it is generally supposed here that the English market cannot tell good cutch from bad; but the fact remains the same, and no cutch-boiler will now add lime under any circumstances. I may relate, *en passant*, that for the last three years a gentleman has been buying pure cutch in the district, and boiling it up again with 25 per cent. of godown sweepings. This he sells in the English market, and I am informed by the agent of a rival firm that this adulterated stuff fetches as high rates in the home market as the best cutch that can be shipped from Burma."

In a note on the manufacture of katha in Kumaon (North-Western Provinces), by Messrs. Hobart Hampden and Blanchfield, Divisional Officers, it is stated that, in choosing the trees, the objectionable practice of chipping them is adopted, and, on the following day, the blaze is examined, and those trees are felled in which there is a white appearance. It has been established by experiment that trees rejected by khairias as unsuitable *do* yield katha, though not in quite as great abundance as the trees which show the white spots. Mr. Hobart Hampden reports that he found that 40 trees without white spots, which had been rejected as unsuitable by the katha-makers, yielded 2 maunds 18 seers 12 chataks of katha as against 3 maunds 25 seers yielded by 40 trees containing white spots.

MANUFACTURE OF CATECHU.

I.—BURMA.

The ordinary process of manufacture, as carried on in Lower Burma, has been described as follows in the report by Mr. Corbett, Deputy Conservator of Forests, already referred to:—

"The trees having been selected are felled and dragged to the cooking place, where they are deprived of bark and sap-wood,

convenient lengths (generally about 7 feet). The next operation is the chipping of the wood. The logs are placed at an angle of about 30° with one end resting on the ground, and the other resting on a wooden support (generally the fork of a tree) fixed in the ground, and are by means of a large heavy *dah* (knife) converted into chips, about an inch square and a quarter of that in thickness. No doubt if the chips were smaller the cutch would be easier to extract, but there would be the disadvantage of the chips rising in the liquid and getting mixed up with the extract, thus causing a diminution of its value. The cooking-place consists of a temporary shed in which the logs are chipped, and near this (under cover during the rains and open during the dry weather) are one or more large pans which will each contain about 12 gallons, each placed over a large fire-place dug out of the ground. Round each pan are ranged from 20 to 24 earthenware pots containing each about 3 gallons. These pots are generally placed over a narrow trench into which the fire-wood necessary to heat them is put. As many chips as the pots will hold are put into the pots, and water is poured in until they are nearly full, and boiled for about 24 hours until the liquid is reduced to about half its original bulk. The liquid from as many pots as it will hold is then poured into the big iron pan and boiled until the bulk is considerably reduced. More liquid from the pots is then added, and the process is repeated until the liquid from the whole of the pots has been made use of. The chips remaining in the pots are rejected, fresh chips are put in, and the process is repeated. The liquid in the cauldron is boiled down until it attains to a viscous consistency (constant stirring being necessary during this part of the process). The cauldron is then taken off the fire, and, to prevent the extract from solidifying at the top before it does so at the bottom, it is constantly stirred with a flat piece of wood shaped like a paddle until it is cold enough to be handled. It is then poured into a brick-shaped mould, generally lined with leaves, and left to cool. The result is a mass of dark cutch varying in consistency according to the quantity of keersal contained in the wood used.

"For the management of one cauldron three men are necessary, one to fell and drag the logs to the cooking-place by means of cattle or elephants, one to clear the logs of bark and sap-wood and convert them into chips, and one to attend to the boiling of the pots and cauldron."

An experiment in the Prome Division has elicited the following data with respect to the extraction of cutch:—

One cubic foot of cutch timber produces 1·36 viss of cutch.

One viss of cutch is obtained from 0·74 cubic feet of wood.

The average day's work of one cauldron consumes 11·61 cubic feet of wood, and produces 15·75 viss of cutch.

In a year of 300 working days the production of one cauldron may equal 4,725 viss of cutch, entailing the consumption of 70 tons of cutch timber.

In Upper Burma the process of manufacture is generally the same as in the Lower Province. In the Yaw forest of the Mu division a somewhat different form of cutch is made. The cutch is boiled in the ordinary manner, and is then thrown into a bamboo basket to see

whether it will set. When it becomes hard it is put back into the cauldron and re-melted. A small quantity of *than* (*Terminalia Oliveri*) bark is added to give a good colour to it and harden it. It is then thrown into small conical moulds made by pressing a blunt-pointed stick into the ground and lining the holes thus made with leaves of either *Cassia Fistula* or *Bauhinia sp.* When the cutch has solidified, the leaf moulds are stripped off the cakes.

"This cutch is made especially for the Shán market, and is only used for chewing, and fetches at Bhamo from R24 to R30 per cwt. The adulteration with *than* is strictly illegal, but, as it gives the cutch a good colour and the Shans are said to prefer it in this form, the manufacture has not been interfered with. The quantity produced is very small.

"From the Sinbyugyun forests of the Minbu Division of Upper Burma I have received specimens of three varieties of cutch, known as black, red, and yellow cutch respectively.* The colours are said to be much more apparent when the cutch is fresh from the boilery. The Deputy Conservator of Forests, Minbu Division, informs me that they are all manufactured by the ordinary Burmese process, the only difference being that the shape of the mould is different, their dimensions being $3' \times 8'' \times 1''$, and that, before the block of cutch has thoroughly set, it is cut into strips about 3 or 4 inches wide, and the block cutch then assumes the form of the slabs found in the market, the dimensions of which are generally $3'' \times 8'' \times 1''$. The classification into the three classes is, apparently, an after-thought of the merchants, and it has not yet been determined to what the characteristic colours are due. This is a point which can only be cleared up by analyses. The cutch is, I believe, undoubtedly pure.

"In the Padaung township of the Prome District a few solitary boilers adopt a different process of manufacture, the product being entirely used for chewing. No iron pans are used. The chips are boiled in the pots in the usual way, and the liquid is then poured into other pots and again boiled until most, but not all, of the water has been driven off. The extract is then poured into a wooden trough about 4' long by $1\frac{1}{2}'$ broad by 1' deep, in which it is agitated constantly by a long stirrer until it commences to solidify. It is then rolled up into balls about the size of a marble, which are placed on palm leaves spread on a bamboo mat, which is then put on a framework about 2 feet from the ground, and a fire, which has to be carefully tended, is lit under it. As soon as the balls begin to swell slightly they are taken off the mat and are ready for market, where they fetch about R30 per. cwt."

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* "Cutch boilers recognize four varieties of *Acacia Catechu*, distinguished by their bark and the colour of the heart-wood, *viz.*—

Sha-ni, or Red cutch.
Shaw-wa, or Yellow cutch.
Sha-bya-kyaung-mwè, or Blue cutch.
Sha-net, or Black cutch.

Of these four varieties the Red cutch is considered the best; the cutch manufactured from the Blue cutch will never 'set' by itself; so, it is always mixed with the cutch from one of the other varieties."—(H. Slave, Cutch Manufacture in Burma, *Indian Forester*, 1892.)

II.—N.-W. PROVINCES.

The following note on the manufacture of Catechu in the Kumaon* Forests was supplied by Mr. Hobart Hampden, Divisional Officer:—

"The boiling places or furnaces (*bhāllis*) consist of platforms some 6' square made of clay with four furnaces in the shape of holes running underneath, from one side penetrating almost to the other side, with three openings to the surface in each. Upon these the earthen pots (capable of containing some 2 pounds of water) are boiled. The fire is kept steady and very hot. The heart-wood of the trees felled is chopped into small thin bits 1 or 2 inches long, which are placed in the boiling pots. The twelve pots are filled two-thirds full of chips, and one-third of water. When the water has evaporated to half-way down the chips, what remains is taken out of eight of the pots and placed in the other four. The eight pots are then refilled. As soon as the liquid contents of the four pots are somewhat further decreased by evaporation, they are poured into a trough made of *Moringa* wood, and castor-oil seed of the weight of half a pice is added, and left while the four pots are again filled with water, the old chips remaining. In half an hour to an hour a sort of cream forms upon the surface of the contents of the *Moringa* trough, which is carefully skimmed off and thrown into a pit in the ground, where it is left until the pit is filled. Then the katha is taken out in cubes of a foot in diameter, dried for two or three days, further cut up and further dried. The eight pots into which fresh water was poured are dealt with in the same way, the process being gone through of pouring the liquor into the four pots. The chips from which the kath has been extracted are utilized a second time, being taken out, put into another trough, and soaked in 4 or 5 seers of water, which is used for boiling with fresh chips.

"The katha boilers in Kumaon pretend that a magic process is gone through with the katha in the pit, which is carefully covered or hidden from view. But the utility of this is probably that the cooling process is gone through at a lower temperature than if the pits were open."

Mr. Blanchfield, Divisional Officer, states that he is informed that during the boiling a stick dipped in castor-oil is used to stir the liquor, and that this is said to prevent the pots boiling over. He further points out that in Kumaon twigs are not dropped into the concentrated katha to aid crystallization, as is said in the Dictionary of Economic Products to be done.

There appears to be a fair local demand for the Kumaon katha, but the manufacture and trade are in the hands of a poor unenterprising people, and there does not seem to be any present promise of much expansion. The khairias refuse to undertake the manufacture except in tracts where the water supply is ample and convenient, and some of the Kumaon forests are badly situated in this respect.

As regards the manufacture of katha in Gorakpur (North-Western Provinces) and Kheri (Oudh) Mr. Hill, Deputy Conservator of Forests, recently prepared the following note:—

"After the khair tree has been selected and felled, it is barked and

* The product produced in Kumaon is nearly pure catechu known as Katha.

cut up into lengths of 6 to 8 feet, the sap-wood removed by an axe, and the remaining khairaha's (native manufacturer's) encampment. This is invariably in the vicinity of water, on the bank of a river or near a lake, and there the manufacture of katha in all its stages is carried on.

"The log of heart-wood having been propped up against two poles, two men proceed to cut it up into chips, which are removed by women and boiled in earthen vessels placed on a long furnace. The furnace, which is made of clay, varies from 10 to 30 feet in length, and is about 2′ 6″ broad and 2′ deep. It is studded with three parallel rows of holes in which the earthen vessels are placed. A vessel on one of the side rows having been filled with chips, sufficient water to cover them is poured in and boiled. When most of the water has evaporated the vessel is again filled with water, and, after the chips have been boiled in all for about three hours, the resulting brown-coloured liquid or extract is poured into one of the vessels in the centre row. The chips are thrown away, fresh chips are put in, and the operation is repeated. The liquor in the central vessels is allowed to boil until it has become of such a consistency that it drips very slowly from a ladle dipped in it. It reaches this state in about three hours. The centre vessels are emptied about four times a day into another vessel, which, when full, is taken away and emptied into a wooden trough inside a grass hut. Four wooden troughs are arranged round a circular vat, which consists simply of a hole about 3′ in diameter and 5′ deep dug in the ground. When the catechu has remained in the trough for about twelve hours, it becomes of a thick jelly-like consistency and of a pinkish hue. It is then scraped out of the troughs and thrown into the centre vat, where it remains for two months or so. It is then taken out, spread on sand, and cut up into little bricks about 3″ × 2″ × 1½″. In this state it is of a dark brown colour, and is ready for market.

"The wood of *Bombax malabaricum* is used for making the wooden troughs, and the khairahas say that the catechu will not set, or will only set very slowly, in troughs made of other woods—*Odina Wodier*, etc.—which have been tried. They say, too, that it will not set in copper, brass or iron.

"Catechu is made during the cold months—December to March—and is prepared for the market in April and May. The khairahas say that it cannot be made in the rains, as it will not set.

"The present amount of *Acacia Catechu* available for the manufacture of catechu is small, the forests having been over-worked, and rest and protection for a considerable period are necessary."

The Government of India have recently suggested that, as the once-flourishing industry of kath manufacture in Oudh seems in danger of becoming extinct in consequence of the gradual extermination of the khair tree by annual savannah fires, it is advisable that — with a view to the eventual revival of the industy — the possibility of reserving one or two compact blocks (at least 12,000 to 15,000 acres) of khair forest in the Kumaon terai, and of arranging for their strict protection against fire and grazing, be considered.

ADULTERATION.

The following information as to the more important adulterants of cutch used in Burma is derived from a note by Mr. Branthwaite of the Forest Department* :—

The adulterants most generally used are decoctions of the bark or wood, as the case may be, of *than* (*Terminalia Oliveri*), *tauk-kyan* (*Terminalia tomentosa*), *lein* (*Terminalia bialata*), *hpangah* (*Terminalia Chebula*), and to a lesser extent of *pyingado* (*Xylia dolabriformis*) and *pyinma* (*Lagerstræmia Flos-Reginæ*).†

1. *Than.*—The bark of the *than* tree, after being chopped up fine, is boiled in water in earthenware pots until all the essences are extracted from the bark. The liquid thus obtained is boiled with the essences similarly obtained from the chopped up wood of the cutch. Cutch thus adulterated can be detected as follows. If only a little *than* is used, little or no harm is done, but the resulting cutch is of a slightly brighter colour and more metallic. If large quantities, however, of the *than* be used, the cutch cakes break with a peculiar metallic fracture, are less bitter in taste, and have a slightly different smell. When largely adulterated with *than*, cutch loses its good properties, goods dyed with it lose their colour when washed, and, owing to the absence of tannin, leather tanned with cutch thus adulterated is of little value.

In the Report of the Chemical Examiner, Rangoon, 1888, *than* is described as being "a red-coloured gum or mixture of gums, insoluble in spirit and having no action on polarized light. Under some circumstances it ferments and evolves gases. It contains no leather-forming property, but is thrown down by gelatine and alum. If, however, this precipitate is boiled in water, the *than* is dissolved." Some specimens prepared for the Imperial Institute fermented, and burst the bottle containing them.

2. *Tauk-kyan.*—Both the bark and wood of this species are used; if the former, the same process is followed as in adulteration with *than*; if the latter, the same method as in boiling cutch itself is followed. Adulteration with *tauk-kyan* can be detected by breaking the cutch cake, when the fracture, which is at first very bright, soon clouds over, losing its lustre. The smell is different, and the taste, instead of being very bitter, is mawkish. In addition to the above differences, the weight of the adulterated cutch is lighter. Owing to the absence or, at least, small amount of tannic acid in the bark and wood of *tauk-kyan*, goods dyed with this mixture soon lose their colour.

3. *Lein.*—The same process is followed when *lein* is used as an adulterant as in the case of *than*. The chopped up wood is not used.

If a stick is thrust into a soft cake, when it is drawn out the adulterated cutch will appear hanging on to the stick in long threads.

If a small quantity of lime be mixed with cutch adulterated with either *lein* or *tauk-kyan*, it turns almost liquid, but, if the lime be added to unadulterated cutch, it becomes hard.

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* *Indian Forester*, 1892.

† Also *ngabè* (*Odina Wodier*), Corbett.

4. *Hpangah.*—This was two or three years ago largely used in the Magwé district to adulterate cutch, but the way in which it is (or was) used was not known to Mr. Branthwaite.

In the note already quoted from (*pp. 8-9*) Mr. Corbett says, with respect to cutch adulteration, that "on ignition cutch should leave a residue of 3 or 4 per cent.; anything above this must be put down to adulteration. Sand, clay, and such like substances are frequently used as adulterants. Their presence may be easily detected by treating the cutch with ether, which dissolves out the catechin and tannic compounds, leaving, with pure cutch, a residue of 47 per cent. The residue in excess of this gives the amount of adulteration." Cutch should be completely soluble in boiling water; if soluble in cold water it may be suspected of impurities or of having been injured by heat.

There appears, according to Mr. Corbett, to be no doubt that adulteration is still carried on to a very considerable extent. At one time it was found that *than* extract was being extensively used for this purpose, and it was put a stop to, first by notifying *than* as a reserved tree, and afterwards by prohibiting the felling or lopping of *than* trees for the purpose of making *than sha* (cutch).

"It is said that Prome was formerly the centre of the cutch industry, but it is probable that now nearly all adulteration takes place in Rangoon, but this is uncertain. Chinese brokers, who have nearly all the trade in their hands, do not own to this adulteration, but they do own to re-melting soft cutch in Rangoon, mixing it with hard cutch, and packing in boxes bearing the mark of the firm. This is probably the time at which the adulteration takes place. It probably also takes place to a slight extent in the Meiktila and Myingyan Districts of Upper Burma. The Minbu and Magwé men say that it is till carried on in Prome with extracts brought from Myingyan in native boats. The Yamèthin men say that the adulteration takes place in Mohloing and Hlaing'de; the Pyinmana brokers say that it is carried out in Yamèthin."

IMPROVEMENT OF MANUFACTURE.

In 1889 Dr. Warth started an enquiry into the reason why the makers of katha refused wood without spots, and only worked up that which was found to have the spots scattered all through the heart-wood. A preliminary examination showed that wood with spots yielded more extract than wood without. Dr. Warth was provided with small samples of woods and extracts made by the katha manufacturers in Oudh and by the cutch manufacturers in Burma.

The following samples of the wood were examined :—

Oudh No. I.—Reported by the *katha* makers as unfit for making *katha*. One in a thousand of the large pores of the heart-wood filled with white substance.

Oudh No. II.—Reported as good for *katha*. About one in six of the large pores filled with white.

Burma A.—Reported by the Burmese as having no white spots. Has no spots, but cracks filled with white matter (*kersal*).

Burma B.—Reported by the Burmese as having spots. One in twenty of the pores white.

Burma C.—Selected by the Forest Officer as having distinct spots. A very beautiful specimen with large white spots. About one in every three pores white.

The following table shows the amount of extract obtained at different trials. The extract was of such dryness that it just began to increase a little in weight on exposure to the air :—

Wood.	Per cent. Extract.	Maximum per cent.
Oudh No. I,	6, 9, 10, 14,	14
Oudh No. II,	4, 15, 15, 16, 17, 19, 23, 24,	24
Burma A,	12, 15, 17,	17
Burma B,	14, 15, 16,	16
Burma C,	16, 16, 20, 20,	20

The following table shows the amount of catechin separated out of the woods. Percentage of catechin in the extract :—

Wood.	Percentage of Catechin in the Extract.	Mean per cent.
Oudh No. I,	33, 38,	36
Oudh No. II,	27, 31, 38, 64,	40
Burma A,	9, 19,	14
Burma B,	17, 46,	31
Burma C,	21, 36,	28

From the above we calculate the total yield of catechin in these five woods as follows :—

Oudh No. I,	5 per cent. catechin from the wood.
Oudh No. II,	9 „ „ „
Burma A,	2 „ „ „
Burma B,	5 „ „ „
Burma C,	6 „ „ „

Subsequently Dr. Warth obtained from Oudh a sample of wood No. 1, from which the local katha manufacturers said that they were unable to make katha. 3·7 per cent. of dry-pressed catechin (the purest katha) and 12 per cent. of pure hard catechu tannin. He proposed the starting of a Government factory in the North-Western Provinces, in which catechin and tannin should be made by an improved method. This method was briefly to consist of cutting up the wood by machinery, boiling the wood and concentrating the liquid in copper vessels, the substitution of a filter press for the wasteful method of filtering through sand, and desiccation of the tannin solution, from which the catechin has been separated, in vacuum pans.*

The opinion of Forest Officers and others was taken with reference to Dr. Warth's scheme, and it was decided that it was not expedient to establish a Government factory, but that the attention of merchants and traders should be called to the experiments made by Dr. Warth with a view to improving the methods of manufacture. It was suggested by a Calcutta firm having large dealings in Burma cutch that this produce, as manufactured by the vacuum pan process, being quite free of catechin, would be much less valuable for dye purposes than the cutch prepared

* See Kew Bull., October—December 1890.

in the rougher manner, as in Burma and elsewhere, by which a large proportion of the catechin is retained in the cutch.

USES.

A.—DYE AND TAN.

For dyeing catechu has been in use in India from a very remote period. A solution of catechu is, by the action of lime or alum, changed into a dull red colour, which constitutes a fairly good dye, and is used for that purpose in some parts of India. The extract may be used, or the heart-wood broken up and boiled with lime. With salts of copper and sal-ammoniac catechu gives a permanent bronze-brown, which is much used by the calico-printers of India. The colour is deepened by the use of perchloride of tin with the addition of nitrate of copper. In Dinajpur (Bengal) the red expectoration from chewing *pán* is preserved and used as an auxiliary in dyeing eri (*Attacus ricini*) silk. Dr. McCann in his 'Dyes and Tans of Bengal' mentions a dye combination, and Mr. (now Sir) E. C. Buck, in his 'Dyes of the North-West Provinces,' adds several others, in most of which lime constitutes the metallic agent. The rationale of these dyes lies in the fact that, under the influence of oxidizing agents (chiefly metallic salts) the soluble catechu compounds are converted into insoluble and thus permanent dyes. By the calico-printers of Upper India 2lb of catechu are boiled in 3 gallons of water. To this solution is added 1lb of shell lime, and the mixture set aside for 12 hours. The surface coloured liquid is skimmed off and preserved as the printing "standard." In this case the oxidization has taken place, or nearly so, before the colour is printed on the fabric. In Europe this is never done; the dye-solution containing soluble catechin and gum is printed on the fabric, and the oxidization accomplished within the tissue. This is a much more effectual and permanent process.

Catechu has long been employed in India for tanning skins, but does not hold a very high position owing to the colour which it imparts to the skin. It is used for a low class of leather which, when made into boots, communicates to the stockings a yellow stain. The principal consumption of catechu occurs in the preparation of fibrous substances exposed to water, such as fishing-lines and nets, and for colouring stout canvas used for covering boxes and portmanteaux.

In the United States miners and working-men wear what are in India called khaki (dirt-coloured) clothes, dyed with catechu.

B.—MEDICINAL USES.

The medicinal properties of the resinous extract of *Acacia Catechu* are similar to those of pale catechu obtained from *Uncaria Gambier*, to which it is said to be preferred in the United States. The resinous extract is a powerful astringent, and may be administered either as a local application or in the form of infusion, tincture, or compound powder.

C.—OTHER USES.

The catechu sold in Calcutta under the name of telá is principally used for strengthening mortar used in the construction of brick buildings in and around Calcutta. It is also used for the manufacture of miniature gardens and other toys given as wedding presents. Native ladies take great pride in making such articles.

PROSPECTS OF THE CUTCH INDUSTRY IN BURMA.

The revenue derived from cutch in the unreserved forests of Upper Burma during the four years 1887-88 to 1890-91 is shown by the following table :—

YEAR.	DIVISIONS.							TOTAL.
	Chindwin.	Katha.	Mandalay.	Minbu.	Mu.	Pyinmana.	Yaw.	
	R	R	R	R	R	R	R	R
1887-88	30	...	...	12,107	...	...	...	12,137
1888-89	280	530	1,240	22,100	2,097	10,430	9,640	46,317.
1889-90	280	460	1,140	23,280	1,940	13,560	10,140	50,800
1890-91	120	1,260	2,320	28,745	6,360	23,120	18,480	80,405

In the Forest Report for Upper Burma, 1890-91, it is stated that "in some parts the cutch has been entirely, or almost entirely, worked out. In others the tree is still plentiful. The question of the measures to be taken to protect cutch in Upper Burma received consideration during the year. The experience of Lower Burma has shown that cutch will be exterminated unless its extraction is carefully regulated. The most effective way of regulating extraction is no doubt to reserve cutch-bearing areas. But reservation is not always possible. It cannot be carried out in tracts where there is a considerable cutch-boiling population. To reserve cutch areas in these localities would be to deprive a large number of people of their means of livelihood. Accordingly, the policy which it has been decided to pursue is to reserve cutch areas which are as yet unworked or are not situated in populated tracts, and to carefully regulate the cutch industry in localities where reservation cannot be carried out. The object which has to be kept in view is to prevent the felling of undersized trees. The felling of undersized trees has always been forbidden by the rules, but difficulty has been experienced in enforcing the law because evidence can rarely be obtained to bring home cases of illegal felling to particular individuals. In order to meet this difficulty it has been decided to insist on the joint responsibility of cutch-boilers for the felling of undersized trees. Cutch-boiling is carried on in small camps of a few workers, who fell trees in the immediate vicinity and drag them to the camp. It has now been made a condition of all licenses that, if an undersized tree is found in

a cutch camp, all the licenses held in that camp shall be liable to be cancelled under the orders of the Divisional Forest Officer. It has further been directed that in future licenses shall be issued by Divisional Forest Officers only, and that large numbers of licenses shall not be given to single speculators. Henceforth licenses will be issued to actual workers only. It is hoped that the effect of the measures stated above will be to prevent the felling of undersized trees in Upper Burma."

The revenue derived from cutch in the unreserved Forests of Lower Burma during the ten years 1881 to 1891 is shown by the following table:—

	Divisions, Lower Burma.							
	Prome.	Tharrawaddy.	Toungoo.	Shwegyin.	Rangoon.	Western.	Thayetmyo.	Total.
	R	R	R	R	R	R	R	R
1881-82	8,365	24,440	2,960	...	...	...	...	35,765
1882-83	22,726	24,220	2,020	...	...	...	...	48,966
1883-84	41,920	38,300	880	...	...	2,005	...	83,105
1884-85	47,920	33,040	558	1,000	100	1,254	...	83,872
1885-86	40,900	12,120	200	...	20	2,180	...	55,420
1886-87	97,740	12,280	180	...	160	1,120	...	111,480
1887-88	143,420	21,560	...	...	120	1,060	...	166,160
1888-89	93,950	16,060	1,820	...	...	2,400	...	114,230
1889-90	6,100	1,260	860	...	...	1,860	56,115	66,195
1890-91	4,660	2,760	600	140	...	2,620	25,930	36,710

The decline of revenue from R1,66,160 to R36,710 in four years must be regarded as a proof of the extent to which the supply of the tree has been exhausted, for the market value of cutch was maintained and even increased during that period. In the Review of the Forest Report for Lower Burma, 1890 to 1891, it is stated that "The Governor General in Council has read, with some concern, the remarks regarding the rapid disappearance of the *Acacia Catechu*, and not feeling satisfied that the step proposed of declaring it a reserved tree, of which, however, His Excellency in Council approves, will entirely meet the difficulties of the case, he considers it advisable that additional Reserves should be constituted in the cutch-growing areas of Burma. It is well known that reservation in these localities presents special difficulties; but, the question being one of great importance, the Government of India desire that the feasibility of such reservation should once more be fully considered."

TRADE RETURNS.

The following table shows the foreign trade in cutch exported from the Port of Rangoon during the year 1891-92 :—

	Quantity.	Value.
	Cwt.	₹
To United Kingdom	86,872	1,442,300
„ Belgium	1,815	34,143
„ France	3,970	69,590
„ Germany	14,579	235,927
„ Holland	2,126	39,170
„ Italy	3,500	74,250
„ Spain	1,300	23,400
„ Egypt	8,884	134,794
„ Ceylon	1,218	25,789
„ China	5	75
„ Straits Settlements	9,410	140,252
TOTAL	133,679	2,219,690

In the 'Report on the Trade and Navigation of Burma,' 1891-92, the value of the exports of cutch during the last five years is stated to have been as follows :—

	₹
1887-88	2,689,463
1888-89	3,077,974
1889-90	2,338,365
1890-91	1,413,354
1891-92	2,219,690

"The large increase," the report states, "in the exports of cutch during 1891-92 as compared with that immediately preceding it, was due to the excellent outturn of this product in the upper province and to a good demand having existed for the European markets. It was generally supposed that the trade in this article in 1891-92 would show a falling off on the previous year owing to the action taken by Government to protect the cutch-producing trees, and to allow trees only of a certain age to be used. But the expectation has not been realized for the reason that most of the boilers removed from Lower Burma, where the restrictions of Government were enforced, to Upper Burma where there was no lack of suitable material. Lower Burma on this account has

produced very little this year, while the supply from Upper Burma far exceeds that of any year on record. The following were the prices during the year:—

Per 100 viss.	Paungdè quality.	Soft.	Tablets.
	R a.	R a.	R a.
April, 1891	51 0	43 4	48 0
May, „	...	46 4	51 12
June, „	...	45 0	50 0
July, „	...	44 0	50 0
August, „	...	45 0	50 0
September, „	...	45 0	50 0
October, „	52 12	46 0	51 0
November, „	61 12	48 0	53 0
December, „	55 8	48 12	52 8
January, 1892	60 0	47 8	53 0
February, „	66 0	43 8	50 0
March, „	60 0	41 0	49 0

The following table shows the exports of Cutch (most, if not all, Burmese) from Bengal for the past five years:—

	1887-88.		1888-89.		1889-90.		1890-91.		1891-92.	
	Cwt.	R	Cwt.	R	Cwt.	R	Cwt.	R	Cwt.	R
To United Kingdom	1,751	34,409	12,026	1,79,779	2,184	34,611	6,282	91,775	10	184
„ France	4,490	86,460	197	3,785	514	10,249	53	580	120	2,400
„ United States	88,342	1,465,913	69,564	1,132,771	62,546	912,353	49,330	746,563	61,796	933,316
„ Ceylon	449	7,240	80	1,225	40	650	31	701	6	144
„ Other countries	3,288	50,463	47	986	468	9,214	3,269	47,500	61	1,555
TOTAL	98,320	1,644,485	81,914	1,318,546	65,749	967,077	58,965	887,119	61,993	937,599

In the 'Report of Sea-borne Trade and Navigation, Bengal,' 1891-92, it is stated that "the exports of *cutch* and *gambier* advanced during the past year, in comparison, with 1890-91, by 5 per cent., but the figures are still below those of previous years.

"Exports to the United Kingdom fell to almost nothing. It cannot be expected that shipments to that country from Calcutta will ever be as large as formerly, since they are now made direct from Burma.

"The United States is the only country receiving *cutch* and *gambier* in any quantity from Calcutta, the increase in the past year nearly being 25⅝ per cent. The previous year was one of small exports, which has naturally been followed by larger shipments, though they were not up to the average of former years. As explained in previous reports, this is merely a transit trade, the *cutch* being sent to Calcutta for convenience of freight, as there is very little communication between Burma and the United States. There is no *gambier* exported, the whole of the shipments consisting of *cutch*."

The imports of cutch from Burma into Bengal during the past five years have been as follows:—

To	1887-88.	1888-89.	1889-90.	1890-91.	1891-92.
	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
Calcutta	115,651	91,300	56,199	63,923	95,970
Chittagong	533	435	343	273	224
TOTAL	116,184	91,735	56,542	64,196	96,194

The exports of cutch from Bombay by sea to foreign countries during the past five years have been as follows:—

COUNTRIES TO WHICH EXPORTED.	1887-88.		1888-89.		1889-90.		1890-91.		1891-92.	
	Cwt.	₹	Cwt.	₹	Cwt.	₹	Cwt.	₹	Cwt.	₹
United Kingdom	5	50	1,704	13,632	...	...	1,000	10,000	...	...
France	...	...	515	4,320	1,080	14,800	987	13,600	...	...
Germany	...	...	...	...	1,000	10,000	2,250	32,525	1,300	13,000
Italy	...	...	563	6,100	...	...	200	3,600	...	...
E. C. of Africa	...	7	6	202	1	40	11	290	1	54
Natal	2	81	...	...	...	...	...	...	...	...
Aden	4	240	6	308	14	795	19	1,112	11	635
Arabia	4	122	3	170	6	210	5	180	4	280
Maldives	...	...	...	...	2	80	...	...	...	...
Persia	4	107	...	...	2	127	...	...	3	135
Turkey in Asia	1	30	1	25	3	110	2	100	4	182
TOTAL	20	637	2,798	24,757	2,108	26,162	4,474	61,407	1,323	14,286

The total exports of cutch from all India during the year 1891-92 are shown by the following table:—

COUNTRY TO WHICH EXPORTED.	QUANTITY.	VALUE.
	Cwt.	₹
United Kingdom	86,882	1,442,484
United States	61,796	933,316
Germany	15,879	248,927
Straits Settlements	9,410	140,252
Egypt	8,884	134,794
France	4,090	71,990
Italy	3,507	74,430
Belgium	1,815	34,143
Spain	1,300	23,400
Ceylon	1,288	27,319
Other countries	82	2,736
TOTAL	197,059	3,172,961

The following quotations of the price of cutch in the London market are taken from S Figgis & Co.'s Fortnightly Price Current:—

Cutch, fair to fine dry, April to 8th September, 1892 . 24/ to 34/
„ „ „ 22nd September to 15th December 20/ to 32/

The following recent market reports are taken from 'Capital,' a Calcutta commercial publication:—

CUTCH.

There has been a sale of 2,000 bags S.M. in diamond, at about ₹11, which appears to have satisfied the demand for the present; seller, however, is not offering any further lot. (November 2nd, 1892.)

Sellers have at last given a quotation, without however attracting any counter offer from America. S.M. in diamond may be quoted at ₹12-4 to 12-8 seller. (December 14th, 1892.)

Has been in better demand with buyers for S.M. in diamond at ₹11-2. The seller has been holding for ₹11-6, but an offer from buyers at ₹11-4 would lead to business. (January 18th, 1893.)

EDGAR THURSTON,

Offg. Reporter on Economic Products to the Government of India.

G. I. C. P. O.—No. 605 R. & A.—17-8-93.—2,000.—J. D'C.

IMPERIAL INSTITUTE SERIES.

HAND-BOOKS

OF

COMMERCIAL PRODUCTS.

INDIAN SECTION.

No. 15.

TURPETH OR INDIAN JALAP.

Published under the Authority of the Government of India.

CALCUTTA.
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1893.

Price one Penny.

PREFACE.

The Government of India have arranged to provide to the Imperial Institute for the illustration of the Economic Products of India—

(A) a descriptive Catalogue or Dictionary;

(B) an index collection of all products;

(C) a commercial collection of special products;

(D) a hand-book descriptive of C.

A.—The descriptive Catalogue has been completed, and is termed the "Dictionary of the Economic Products of India." The compilation has occupied eight years, and has been made under the Editorship of Dr. G. Watt, C.I.E., Reporter on Economic Products to the Government of India. It has been confined to the collation of facts and statistics available up to the date of the publication of the work.

To each product there is assigned in the Dictionary a separate number, which will be permanently maintained for purposes of reference.

B.—The index collection will, when completed, be comprised of small samples of every economic product of India, which will bear the same numbers as those assigned to the products in the Dictionary.

C.—The commercial collections are on a larger scale. The number of products of which a collection is provided each year will be limited to about twenty.

Each collection will comprise as complete a set of specimens of the product in its raw and manufactured state as is necessary for the fulfilment of the object with which the commercial collections and hand-books are provided.

D.—The hand-books will supply, in a separate pamphlet for each product, the information contained in the Dictionary, amplified by supplementary facts and statistics, and illustrated by maps, diagrams, photographs, etc.

The objects of the commercial collections and hand-books which accompany them are—

1. To secure, while each collection is being made for the Institute, a thorough and special investigation in India through which fresh information regarding the product concerned, not contained in the Dictionary, may be obtained.
2. To illustrate the Dictionary in a manner more complete than can be effected by the index collection,
3. In the case of products which are not generally known—
   - (*a*) to bring them to the notice of those interested;
   - (*b*) to indicate the extent to which, and conditions under which they are procurable;
   - (*c*) to ascertain their commercial value;
   - (*d*) to secure, through the Governing Body of the Institute and commercial experts whom they may consult, such special trial or analysis of them as can be more effectually made in England than in India.

E. C. BUCK,

Secy. to the Govt. of India,
Dept. of Revenue and Agriculture.

[This product is described in Dr. Watt's Dictionary of Economic Products. Vol. IV, 415-419.]

TURPETH OR INDIAN JALAP.

In this hand-book the article in the Dictionary of Economic Products by Dr. G. Watt has been reproduced with additions. Turpeth root is used as a substitute for Jalap by Native practitioners, who consider that the adverse opinion held by European authorities is largely due to the whole root having been used instead of the root-bark. It is desirable that the real merits of the drug should be determined.

Ipomæa Turpethum, *Br.; Fl. Br. Ind., IV, 212.*

TURPETH ROOT or INDIAN JALAP.

Syn.—CONVOLVULUS TURPETHUM, *Linn.; Roxb.; Wight; Hassk.;* C. ANCEPS, *Linn.;* C. TRIQUETER, *Vahl.;* I. ANCEPS, *R. & S.; Bl.; Chois.;* I. TRIQUETRA, *R. & S.;* SPIRANTHERA TURPETHUM, *Bojer;* OPERCULINA TURPETHUM, *Manso.*

Vern.—*Nisoth, tarbud, nukpatar, pitohri,* HIND.; *Teori, dhud kalmi* (or *dudiya-kalmi*), BENG.; *Bana etka,* SANTAL; *Chita bánsa* (the root in bazárs, *turbud, nisot*), PB.; *Nishotar, phútkari,* BOMB.; *Nishottara,* MAR.; *Nashotar,* or *nahotara,* GUZ.; *Tikuri,* DEC.; *Shivadai,* TAM.; *Tella tégada, tégada,* TEL.; *Bilitigadu,* KAN.; *Trastawálu,* SING.; *Trivrit, triputa,* SANS.; *Turbund,* ARAB.

Habitat.—Found throughout India, ascending to altitudes of 3,000 feet. Distributed to Ceylon, South-East Asia, Malaya, Australia, etc.

Cultivated occasionally in gardens as an ornamental plant; it grows well, for example, in the Botanic Gardens, Calcutta. The supply for medical purposes is, however, derived entirely from the wild plant. The Surgeon General, Bombay, reported that the plant is extremely cheap, selling at R7 a cwt.

Medicine.—Dutt (*Hindu Materia Medica*) says of this drug: "Two varieties of *trivrit* are described by most writers, namely, *sveta* or white, and *krishna* or black. The white variety is preferred for medical use as a moderate or mild cathartic. The black variety is said to be a powerful drastic and to cause vomiting, faintness, and giddiness. *Trivrit* has been used as a purgative from time immemorial, and is still used as such by native practitioners, alone as well as in various combinations. In fact, this medicine is the ordinary cathartic in use amongst natives, just as Jalap is among Europeans. The usual mode of administering it is as follows:

About two scruples of the root are rubbed into a pulp with water, and taken with the addition of rock salt and ginger or sugar and black pepper." Roxburgh wrote in his *Flora Indica* of this drug that "the bark of the root is by natives employed as a purgative, for which they use it fresh, rubbed up with milk. About 6 inches in length of a root as thick as the little finger they reckon a common dose." In a separate and more recent note on this subject he says, quoting Dr. Gordon: "The drug which this plant yields is so excellent a substitute for jalap, and deserves so much the attention of practitioners, that I doubt not the following account will prove acceptable. It is a native of all parts of continental and probably of insular India also, as it is said to be found in the Society and Friendly Isles and the New Hebrides. It thrives best in moist shady places on the sides of ditches, sending forth long, climbing, quadrangular stems, which in the rains are covered with abundance of large white, bell-shaped flowers. Both root and stem are perennial. The roots are long, branchy, somewhat fleshy, and when fresh contain a milky juice, which quickly hardens into a resinous substance altogether soluble in spirits of wine. The milk has a taste at first sweetish, afterwards slightly acid; the dried root has scarcely any perceptible taste or smell. It abounds in woody fibres, which, however, separate from the more resinous substance in pounding, and ought to be removed before the trituration is completed. It is, in fact, in the bark of the root that all the purgative matter exists. The older the plant the more woody is the bark of the root; and if attention be not paid in trituration to the removal of the woody fibres, the quality of the powder obtained must vary in strength accordingly. It is probably from this circumstance that its character for uncertainty of operation has arisen, which has occasioned its disuse in Europe. An extract, which may be obtained in the proportion of one ounce to a pound of the dried root, would not be liable to that objection. Both are given in rather larger proportion than jalap. Like it, the power and certainty of its operation are very much aided by the addition of cream of tartar to the powder, or of calomel to the extract. I have found the powder in this form to operate with a very small degree of tenesmus and very freely, producing three or four motions within 2 to 4 hours. It is considered by the natives as possessing peculiar hydragogue virtues, but I have used it also with decided advantage in the first stages of febrile affections."

About the same time that Roxburgh was examining *turbud*, Ainslie was engaged in writing his *Materia Indica*, and in addition to much interesting information derived from other sources, he republished the further facts given in Carey and Wallich's edition of Roxburgh's *Flora Indica*, in which Wallich, Gordon, and Glass pronounce the root "a medicine of very considerable value as a cathartic." Ainslie urges that it is in the root-bark, not in the entire root, that the medicinal property resides, so that the drug may be depreciated by the use of the whole root. Ainslie remarks: "In the valuable Sanskrit Dictionary, the *Amara Kosha*, and also in the *Bhávaprakása* and *Rájanighantu*,* may be found many synonyms for this plant; in the last of these the root

* These Mr. Colebroke mentions as amongst the best writings of the indus on Materia Medica.

in question, *teori* (BENG.), is recommended as of use in removing worms and phlegm." "Our present article," he continues, "had long a place in the British Materia Medica (*Convolvulus indicus, Alatus maximus*), but of late years it has fallen into disuse. I find it mentioned by Avicenna (264) under the name تربد *turbad;* but the firs amongst the Arabs who prescribed it was Mesue, who gave the root, in powder, to the extent of from ʒi to ʒii, and of the decoction from ʒii to ʒiv. Alston, in his *Materia Medica* (Vol. II, 530), speaks of *turbith* as a strong and resinous cathartic, and recommended in his days in gout, dropsy, and leprosy. The plant is known to the modern Greeks by the name of *τυρπεθον*." "Virey speaks of the root of the *Convolvulus Turpethum* as more drastic than the common Jalap." Muhammadan physicians recognise, like the Hindus, two forms of *turbad*, a white and a black, and recommend that the black should be avoided on account of its poisonous properties.

In India the usage of this drug, apparently, fell off after the appearance of O'Shaughnessy's *Bengal Dispensatory*, where he wrote, while commenting on the facts published in *Roxburgh's Flora of India*, "We have also subjected its properties to careful clinical experiment, and we feel warranted in asserting that the action of the medicine is so extremely uncertain that it does not deserve a place in our Pharmacopœia." That verdict was reproduced in Waring's *Pharmacopœia of India*, and European interest in the drug, from the date of that work, may be said to have died out. It will, however, be found (from the selection of special opinions quoted below) that native practitioners continue strongly in favour of it, and that Dr. Moodeen Sheriff and others think that the adverse opinion held by European authorities is largely due to the whole root having been used instead of the root-bark. In this opinion Merat and De Lens concur, recommending that the roots should be chosen in which the bark is intact, "as most of the activity of the root resides in that part."

In the Madras bazar two kinds of *sevadai* are sold, *viz.:* (*a*) white, (*b*) country (*nattu sevadai*, Tamil; *nattu tegada*, Telugu).

The latter is procured from the suburbs of Madras, and sold at the rate of 2 annas per pound, or Rs. 3-2 per maund (25 lbs.).

Botanical specimens of country *sevadai*, which is used when white Turpeth is not procurable, have not yet been received for identification.

The wholesale price of white Turpeth (obtained from Bombay) in the Madras bazar is Rs. 6-4 per maund, and the retail price Rs. 8-5-4 per maund. It is not sold by European chemists, as it is not an officinal drug.

Chemistry—The bark is without odour and has little taste. "Examined by M. Bontron Charland it was found to contain resin, a fatty substance, volatile oil, albumen, starch, a yellow colouring matter, lignin salts, and oxide of iron. The root contains 10 per cent. of resin (*Andouard*). According to M. Spirgatis, this resin is a glucoside, turpethin, C_{36} H_{56} O_{16}, like that of other Convolvulaceæ insoluble in ether, but soluble in alcohol, to which it imparts a brown colour not removable by animal charcoal. To obtain it pure the alcoholic solution is concentrated; the resin precipitated by water, boiled with this vehicle,

then dried, reduced to powder, digested with ether, and finally redissolved by absolute alcohol, and thrown down by ether." "It is inflammable, burning with a smoky flame, and emitting irritant vapours." (*United States Dispensatory, 15th ed., 1770*). According to Spirgatis turpethin is only present in the root to the extent of 4 per cent. Under the action of alkaline bases it is transformed into turpethic acid (C_{34} H_{60} O_{18}), and by hydrochloric aud other dilute acids it is decomposed into turpetholic acid (C_{16} H_{32} O_4) and glucose (*Watts' Chemistry, V., 925-926*). According to Dr. Dymock the flowers are in Western India applied to the head in hemicrania.

Special Opinions.—"My experience of the root of *Ipomœa Turpethum* is much greater now than nineteen years ago, when I spoke of it in the *Supplement to the Pharm. of India,* pages 346—348. There are two varieties of it, which are well known in the bazár as *sufed-turbud* and *kała-turbud*, or the white and the black turpeth root, respectively. The drug consists of pieces of root and root-bark, and the latter being the best and not generally sold separately in the bazár, requires to be picked out. The root-bark occurs in cylindrical pieces, varying in length from 2 to 4 inches, and in thickness from one quarter to one inch; quilled or curved; smooth but often wrinkled longitudinally; taste slightly acrid, and odour agreeable if new. The colour of the white variety is grey or reddish-grey; and of the black, brown. The cut ends of the piece, particularly in the white variety, are often covered with some resinous substance. The thickness of the bark itself is about a line or two, and the bark of the white variety is generally thicker than that of the black.

"The turpeth root, notably the white variety of it, is quite equal to jalap and superior to rhubarb in its action, and preferable to both for having no nauseous smell or taste, and for being a very efficient and satisfactory purgative when used alone. Its dose is somewhat larger than that of jalap, but this is no disadvantage, as long as it is safe and free from nauseous taste and smell. The dose is larger only by 10 or 15 grains. As a cathartic and laxative, the turpeth root is useful in all the affections in which either jalap or rhubarb is indicated. The best way of administering it is in simple powder; but it may also be employed in combination with cream of tartar in equal proportion, and with or without a few grains of ginger in each drachm of the compound powder. Dose of the simple powder is from 50 to 70 grains, and of the compound powder from a drachm to 90 grains." (*Honorary Surgeon Moodeen Sheriff, Madras.*) "What is sold as black turbud has the same structure as the white, but it is of smaller size and darker colour." (*Surgeon-Major Dymock, Bombay.*) "Used as a purgative by native practitioners." (*Civil Surgeon W. H. Morgan, Cochin.*) "Is a purgative which is very frequently used with rock salt and long pepper." (*Surgeon-Major Robb, Civil Surgeon, Ahmedabad.*) "The root powdered in doses of a drachm and a half is used as a purgative, but is less efficient than káládáná." (*Hospital Asstt. Lal Mahomed, Hoshangabad, Central Provinces.*)

Mr. T. N. Mukharji suggests that the uncertain action of the drug, purchased from the bazár, which has been referred to above (p. 3) may be due to the admixture of the roots of *Ipomœa bona-nox.* The two roots, when dry, cannot be easily distinguished from each other. The

plants, however, though resembling each other can be easily identified. *I. bona-nox* has a round stem, while that of *I. Turpethum* is ribbed. The flowers and seeds of *I. bona-nox* are also larger than those of *I. Turpethum*.

EDGAR THURSTON,

Offg. Reporter on Economic Products to the Government of India.

G. I. C. P. O. No 25 R. & A.—8-5-93.—1,500.

IMPERIAL INSTITUTE SERIES.

HAND-BOOKS

OF

COMMERCIAL PRODUCTS.

INDIAN SECTION.

No. 16.

KAMELA DYE.

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CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1893.

Price one Penny.

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D.—The hand-books will supply, in a separate pamphlet for each product, the information contained in the Dictionary, amplified by supplementary facts and statistics, and illustrated by maps, diagrams, photographs, etc.

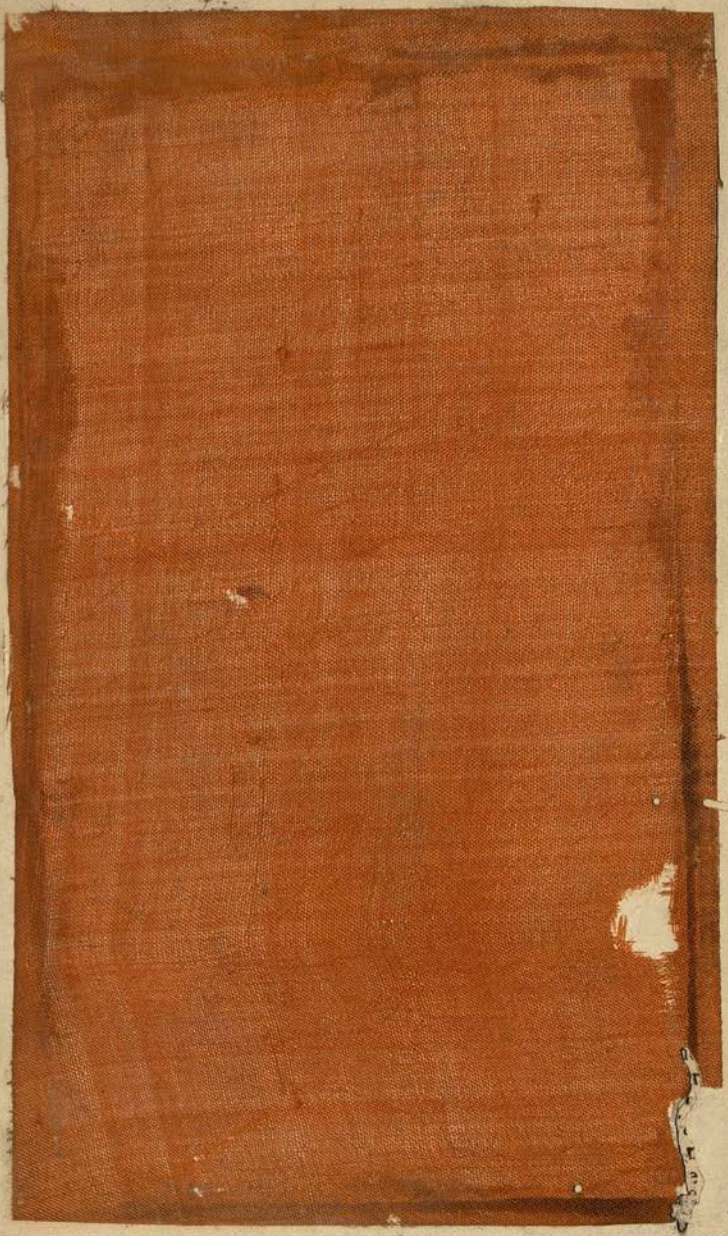
The objects of the commercial collections and hand-books which accompany them are—

1. To secure, while each collection is being made for the Institute, a thorough and special investigation in India through which fresh information regarding the product concerned, not contained in the Dictionary, may be obtained.
2. To illustrate the Dictionary in a manner more complete than can be effected by the index collection.
3. In the case of products which are not generally known—
   (*a*) to bring them to the notice of those interested;
   (*b*) to indicate the extent to which, and conditions under which they are procurable;
   (*c*) to ascertain their commercial value;
   (*d*) to secure, through the Governing Body of the Institute and commercial experts whom they may consult, such special trial or analysis of them as can be more effectually made in England than in India.

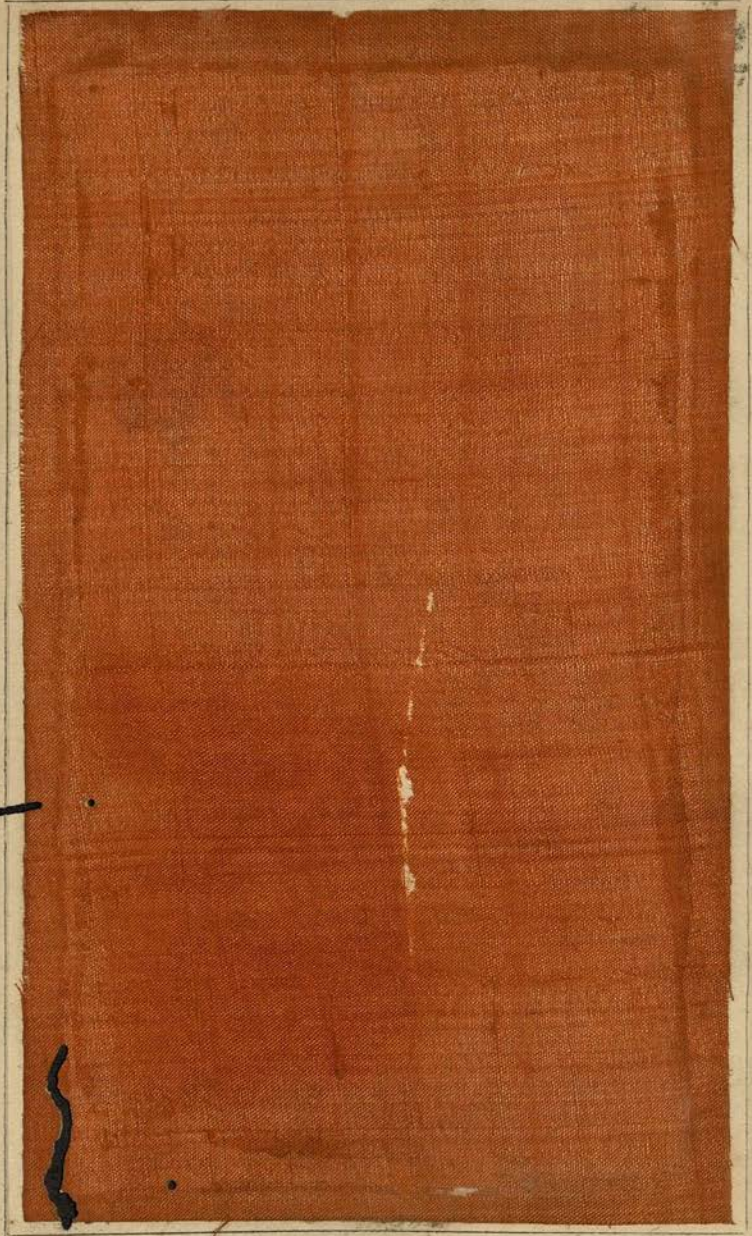
E. C. BUCK,

Secy. to the Govt. of India,
Dept. of Revenue and Agriculture.

Sample of silk dyed with Kamela.



Sample of silk dyed with Kamela and Arnotto.



[This product is described in Dr. Watt's Dictionary of Economic Products, Vol. V., M. 71—86.]

KAMELA DYE.

In this hand-book the information contained in the Dictionary of Economic Products has been reproduced with additions. *Kaméla* dyes silk a deep, bright, durable, orange or flame-colour of very great beauty. If a demand for it were to arise, the supply could be almost indefinitely increased, without the necessity of cultivation, for many years to come.

Mallotus philippinensis, *Muell. Arg.; Fl. Br. Ind., V., 442.*
THE MONKEY-FACE TREE.

Syn.—ROTTLERA TINCTORIA, *Roxb.;* R. AURANTIACA, *Hook. & Arn.;* R. AFFINIS, *Hassk.;* R. MONTANA and MOLLIS, *Wall.;* CROTON PHILIPPINENSIS, *Lamk.;* C. PUNCTATUS, *Retz.;* C. COCCINEUS, *Vahl.;* C. MONTANUS, *Willd.;* C. DISTANS, *Wall.;* C. CASCARILLOIDES, *Rauesch.*

Habitat.—A small, evergreen tree, found throughout Tropical India; along the foot of the Himálaya from Kashmír eastwards, ascending to 5,000 feet; all over Bengal and Burma, Singapore, and the Andaman Islands; and from Sind southwards to Ceylon. Distributed to China, the Malay Islands, and Australia.

HISTORY.

Much has been written regarding the *kaméla* dye (or, as it is known in Europe, *kamala*). This is the powdery substance obtained as a glandular pubescence from the exterior of the fruits of *Mallotus philippinensis*. Even at the present day, however, *kaméla* dye cannot be said to have obtained the position in European commerce which its merits deserve. In India it is sometimes known by its Arabic name *kinbíl* (a word derived from the Sanskrit name for the drug); but, according to certain Arabian writers, there were two kinds of *kinbíl*—the red Indian and the black or purple Abyssinian. It has now been ascertained that the darker coloured *kinbíl* is the African *wars* or *waras* drug and dye, the substance obtained from *Flemingia congesta*. The Indian *kinbíl* appears, in fact, to have at one time been chiefly used as an adulterant for *wars*, and as such it first found its way to Europe. The history of the black *kinbíl* has been more carefully worked out than the red, though what is apparently the latter is mentioned in the *Cir-*

kradatta-sangraha and in the *Bhávaprakása* (A.D. 1535), and hence was probably known to the later Sanskrit medical writers. Professor Wilson was of opinion that the Arabians of the eighth century studied Hindu medicine before that of the Greeks, and that Chakrapáni Datta's great work was translated into Arabic about A.D. 773. From that period the name *kinbíl* probably dates. Arabian writers of an earlier period appear to allude exclusively to *wars*, the synonym *kinbíl* being given by commentators or translators. Thus Paulus Ægineta in the seventh century refers to *wars*, and Ibn Khurdadbah, who lived A.D. 869-885, states that from Yemen came stripe silks, ambergris, *wars*, and gum. *Kinbíl* is sometimes compared by the Arabian writers to saffron, hence in all probability the modern, though inaccurate, application of the vernacular name *késar* in some parts of India. This mistake was made by Brandis, Gamble, Bentley and Trimen, etc. In the tenth century, Masundi wrote of *kinbíl* as a sandy substance of a red hue, which was useful as an anthelmintic and in the treatment of cutaneous diseases. In the thirteenth century, Kazwini referred to *wars* as a plant sown in Yemen which resembled sesam. Most writers from that date carefully distinguish *wars* from *kinbíl*, and speak of the former as a dye and medicine used externally to remove freckles and taken internally to cure leprous eruptions. They seem to have understood that the red *kinbíl* was an anthelmintic drug—a property not possessed by *wars*. The *Makhzan-al-Adwiya* makes the same distinction, but says the *kinbíl* is the pulp of a fruit obtained from a tree growing on the mountains which has long stiff thorns. It is thus probable that Mir Muhammad Husain never saw either the tree or the fruits from which the *kaméla* powder is obtained. His description of the fruit and of the powder obtained from the interior (instead of from the outer surface) is curiously enough almost identical with that incorrectly given by Liotard, McCann, and other popular modern writers on the dyes of India. Of *wars*, Mir Muhammad remarks there is a black kind which comes from Ethiopia, called *Habshi*, and a dull red kind known as Indian, the latter yielding an inferior dye. He then adds that the seeds of the *wars* plant resemble those of *másh* (=*Phaseolus Mungo* var. *radiatus*), a fact which recent investigation has confirmed, by the determination of *wars* as the glandular pubescence from the pods of a *Flemingia*.

The vernacular names used in India to denote the *kaméla* powder imply its colour, but they are the same names as are given to the disease jaundice. It is somewhat remarkable, however, that the earliest European writer who deals with *Mallotus philippinensis* should neither have heard of its dye nor of its anthelmintic property. In 1684, Rheede (*Hortus Indicus Malabaricus*) described and figured the plant, but he speaks of the leaves and fruits as being made, along with honey, into a cataplasm employed in the treatment of itch and for application to the bites of snakes and other venomous animals. Similarly, the root, he adds, was made into a preparation found valuable in the treatment of contusions, since it possessed the property of dissolving coagulated blood. He does not appear to have heard of the powder, nor does he call the plant by a name in any way traceable to the names in modern

use. He calls it *Ponnagam*, but, as with Roxburgh's *Pnag*, that name should in all probability be assigned to *Calophyllum inophyllum*. Dr. Hove, an indefatigable traveller and botanist, who visited Bombay in 1787, alludes to *kaméla* apparently, but under another incorrect name—'*Kissury*'—as being used to adulterate a permanent dye prepared from *Bixa orellana* by combining the dye from the seeds with that prepared from the roots and leaves.

The reader will find in the Selections from the Records of the Government of India, Revenue and Agricultural Department, 1888-89, pp. 53-58, an account of Hove's dye, and perhaps the facts there given may be found interesting, because of their bearing on the subject of *kaméla*. Most writers speak of Buchanan as having been the first European writer who described *kaméla* dye. The diary of his journey through Mysore, in which he gives particulars of the process then in use, is dated 1807, but Roxburgh's *Coromandel Plants* was published in 1798. In that work the subject is discussed in great detail, and the genus *Rottlera* founded by Roxburgh, in order to isolate from *Croton* the *kaméla* and one or two allied species. The specific name of *tinctoria* given by Roxburgh denotes its dye property as being then recognised, but in his *Flora Indica* he adds that "the root is said to dye red also."

The properties of both the dye and medicine are, at the present day, appreciated by the people in every province of India. It is mentioned in most of the Gazetteers and District Manuals, but the following special authors may be consulted regarding the substance:—

In Bengal, Roxburgh, Dutt, Gamble, Liotard, McCann; in the North-Western Provinces, Brandis, Buck, Atkinson; in the Panjáb, Stewart, Baden Powell; in Bombay and Sind, Birdwood, Murray, Dymock, Lisboa; in Madras, Elliot, Moodeen Sheriff, Bidie, Drury; and in Burma, Mason, Kurz, etc.

The statement, made originally by Roxburgh, that the roots afford a red dye, has been confirmed by Schlich and by Kurz. All other writers who allude to this subject appear to have been compiling from Roxburgh, so that it would seem that the dye property of the roots is not generally known, or has, within the present century, been lost sight of through the introduction of cheaper and more convenient dyes. A similar disappearance of knowledge has been incidentally alluded to above in connection with *Bixa orellana*—a permanent dye having, according to Dr. Hove, been prepared in Bombay in 1787 through combination of the colour from the seeds with that prepared from the roots and leaves. *Kaméla*, he tells us, was employed to adulterate that permanent dye preparation from *Bixa*. But even at the present day certain writers speak of *kaméla* as used to adulterate arnatto. It is thus probable that this practice was the outcome of the fact that the introduction of arnatto displaced *kaméla*, the latter being continued as an adulterant only. Though much inferior to *kaméla* in many respects, arnatto is a simpler and cheaper dye, eminently suited for temporary tinctorial purposes, such as the *abir* of the Holi festival. The inference is thus probably admissible that *kaméla* was the dye which Buchanan (*Statistical Account of Dinájpur*) informs us was displaced by the then recently

introduced arnatto in the province of Behar. So far as the writer can discover, however, the dye property of *kaméla* was at least not generally known in India much more than 200 years ago, and it seems highly probable that its medicinal virtues were notfully appreciated until a considerably later date. It is at least significant that painstaking investigators, such as Ainslie, Elliot, Roxburgh, Honigberger, and O'Shaughnessy, should have been ignorant of the fact (if fact it was, at the beginning and during the first half of the present century) that *kaméla* was deemed by the people of India their most effectual anthelmintic drug. Ainslie does not so much as mention the plant by name, and Elliot and Roxburgh deal with it only as a dye. The former author informs us that with the Telugu-speaking people it was in his time known as wild arnatto (*Kondu* or *Karujáphara*). Throughout India there is a singular tendency to give to the dye the vernacular names for the disease jaundice (*i.e.*, *kápila*, *kamila*, *kaméla*, *khamalai*, *etc.*, *etc.*), a comparison doubtless suggested from the resemblance of the dye to the jaundice skin. But a comparative name, such as the above, stands every chance of being of modern origin, the more so since four or five other silk dyes are nearly always confused with the *kaméla* of more precise modern writers. Of these may be mentioned *Calophyllum inophyllum*, *Crocus sativus*, *Mesua ferrea*, *Ochrocarpus longifolius*. The first is apparently the true *Pannága* of Sanskrit writers, though Roxburgh gave that synonym to *Mallotus*; so also the *Crocus* is the true *Kesar*, though that name is sometimes given to *kaméla*. While such confusions exist, we have the assurance of Udoy Chand Dutt that the *Kampilla* and *Rechanaka* of the more recent Sanskrit medical writers was *Mallotus philippinensis*, and since it was by them recommended as an anthelmintic, it seems probable that his determination is correct, and consequently that the knowledge of this drug may have migrated from India to the Arabian and Persian physicians, and returned again when an import trade was established in the Ethiopian, Arabian, and Abyssinian drugs with which it became confused by modern writers. Flückiger and Hanbury (*Pharmacographia*), Bentley and Trimen (*Medical Plants*), and several other authors state that *Mallotus philippinensis* is a native of Abyssinia, Southern Arabia, and India. This is probably a mistake, the genus *Mallotus* being sparsely distributed to Africa. There are, however, three or four Abyssinian species and several members of allied genera, some of which appear to possess the medicinal properties of the *kaméla*. At one time, for example, considerable interest was taken in *Cortex musenæ*, the bark of *Croton macrostachys*, A. Rich. (*Rottlera Schimperi*, Hochst), a tree met with in Abyssinia, which, by the natives of that country, is held in esteem as an anthelmintic. The frequent reference, by the older writers, to Abyssinian *kinbíl*, leaves it probable that we shall yet discover that an African or Abyssinian species of *Mallotus* may actually have produced the drug in question, though modern writers assume that the Abyssinian supply must have been drawn from India. If this suggestion proves correct, the Indian knowledge of *kaméla* may have been the result of an Abyssinian imported drug being recognised as identical with an indigenous substance not previously utilized.

Statistics and Prices.—With so extensive an amount of accessible literature as exists on the subject of *kaméla*, it does not seem necessary that detailed information should be given for each province. The tree is wild, and apparently nowhere cultivated; the powder is obtainable in any local bazár and within easy reach of the chief seaports. If a demand were to arise, the supply might be almost indefinitely increased without, for many years to come, necessitating cultivation. Though statistics cannot be given of the present Indian consumption or of the export, the writer, from personal knowledge of India, feels that he is within the mark when he affirms that considerably less than half the amount produced is at present utilised. It is quite customary to find, in the sub-tropical forests, miles of country with here and there trees each bearing a mass of over-ripe powdery capsules, the *kaméla* from which is simply being allowed to run to waste. Many writers allude to the extent of the local trade. Thus, for example, Mr. Atkinson informs us that 2,000 maunds are annually exported from Kumáon. The known extensive use of *kaméla* as a silk dye is, however, a better criterion of the magnitude of the trade than the published statistics of any one district or province, since particulars of a limited number of districts only have been published, and the demand is for local rather than foreign markets.

The powder seems to vary greatly in price in the various districts of India. Dr. Dymock says that in Bombay it sells for ₹11 per maund of 41lb. Lisboa remarks: "If the berries be plucked too early, this dust (*kaméla*) is mixed with another sort, of a greenish tint, which destroys the value of the article, and if not plucked at the right time, the dust will all disappear, being blown away by the wind, leaving the berries of a greenish-brown colour and of no value. The article *kaméla* finds a ready market, and is now worth one shilling and six pence a pound." Buck says that in the bazárs of the North-Western Provinces the *kaméla* powder sells at ₹22 per cwt. The price in Bengal will be found in the passage below describing the process of dyeing which is pursued in the Lower Provinces. Regarding Nundydrug Division, Mysore, it is stated that one-eighth of the quantity produced is used locally, and that the average annual production is a little over 2 tons, and the average price ₹6 to ₹7 per maund.

CHEMISTRY.

Kaméla powder was first examined by the late Professor Anderson, of Glasgow University, and subsequently by E. G. Leube, junior. The opinions originally published by these chemists have been reproduced in all subsequent medical works which have appeared in Europe, America, and India without apparently any additional information being brought to light. The powder is said to be aromatic, is but slowly wetted by water, and yields but little colour even to boiling water, colouring it pale yellow. In the presence of alkaline carbonates and caustic alkalies, especially the latter, it forms deep red solutions. The extract prepared with soda imparts to silk a fine and durable fiery-orange colour without further addition or the use of mordants: with cotton,

on the other hand, it does not produce a good colour. The natural dye stuff contains 3·49 per cent. water, 78·19 resinous colouring-matters, 7·34 albuminous substances, 7·14 cellulose, and 3·84 ash, besides small quantities of volatile oil and a volatile colouring matter. The liquid distilled from the alcoholic extract has a yellow colour and the odour of the original substance. The concentrated etherial extract of the colouring matter deposits a yellow crystalline substance called *rottlerin*. The extract, prepared with boiling alcohol, deposits, on cooling, non-crystalline flecks of a substance having the composition of $C_{20}H_{34}O_4$. It may be obtained nearly colourless, by repeated solution and separation; it is sparingly soluble in ether and in cold alcohol, insoluble in water; not precipitated by lead or silver-salts. The alcoholic solution separated from these flecks leaves a dark-red resin, $C_{30}H_{30}O_7$, soluble in all proportions in alcohol and ether, insoluble in water, melting at 100°, and forming with acetate of lead a deep orange-coloured precipitate of variable composition (*Anderson, as given in Watt's Chemistry.*)

The authors of the *Pharmacographia* state that, so far as their experiments go, they have been able to confirm Anderson's results. They found that the resin was also soluble in glacial acetic acid or in bisulphide of carbon, but not in petroleum ether. The chemi stry of the action of *kaméla* as a purgative and anthelmintic does not appear to have been established. Anderson does not affirm that his *rottlerin* is the active principle of the drug.

PROCESS OF DYEING.

The brief account of the chemistry of this substance given above expresses the *rationale* of its use as a dye. The ripe fruits are collected by the people, placed in a cloth or sac, and beaten until the glandular pubescence is removed from the exterior of the fruits. The powder thus obtained is then sifted to free it from the fruits and broken pieces, and in this condition it is ready for the market. The following account from Roxburgh's *Coromandel Plants* may be given in its original form. It conveys very nearly all we know on the subject, and has a historic interest as being the first account of the substance :—

"The red powder, which covers the capsules, is a noted dyeing drug, especially among the Moors, and constitutes a considerable branch of commerce from the mountainous parts of the Circars. It is chiefly purchased by the merchants trading to Hyderabad and other interior parts of the Peninsula.

"When the capsules are ripe, or full grown, in February and March, they are gathered : the red powder is carefully brushed off and collected for sale, no sort of preparation being necessary to preserve it.

"This substance like arnatto is difficultly acted on by water; it communicates no particular taste, either by infusion or decoction, and only a pale straw colour, which acids scarcely alter, but alkalies brighten and deepen. To spirits it very rapidly gives a rich, deep, flame-coloured orange, inclining to red. Alkaline salts enable water to extract a very

deep blood-red, which, on agitation, produces an orange-coloured froth, and tinges the sides of the vial. Neither spirits nor alkaline solutions dissolve it, for the distinct minute grains of the powder are seen adhering, in their original state, to the sides of the vial, when shaken, but are now of a bright gold or orange colour, about the size of very minute grains of sand: in this it differs widely from arnatto, which is soluble in both these menstruums. Alum, added to the alkalised infusion or decoction, renders the colour brighter and more permanent; tartar (to appearance) in a great measure destroys it, yet the mixture dyed white silk of a very beautiful colour, if possible, superior to any other I have tried.

"This red powder dyes silk a deep, bright, durable orange or flame colour of very great beauty. The Hindu silk-dyers use the following method:—

"Four parts of *wassunta-gunda* (Holi powder), one of powdered alum, two of salt of soda (native barilla), which is sold in the bazárs, are rubbed well together with a very small proportion of oil of sesamum, so little as hardly to be perceptible; when well mixed, the whole is put into boiling water, proportionate to the silk to be dyed, and kept boiling smartly more or less time, according to the shade required, but turning the silk frequently to render the colour uniform."

Sir E. C. Buck (*Dyes and Tans of the North-Western Provinces*, 31) says: "The dye obtained from the fruits is used in dyeing silk and wool, giving a rich flame colour of great beauty and permanence. It does not require a mordant, all that is necessary being to mix it with water containing about half its weight of carbonate of soda. The dye was very favourably reported on by the jurors of the Madras Exhibition as being especially valuable for silk. The bark of the tree is used in tanning leather. It is imported into these provinces from the Sub-Himálayan forests and Calcutta, and sells in the bazár at R22 per cwt. When used it is simply pounded and dissolved in water." Colonel Beddome (*Fl. Sylv.*, *t.* 289) writes: "The red mealy powder of the capsules is a valuable product, and might be a source of considerable revenue in many of our forest districts; it is used as an orange dye principally for silk. The ripe capsules are gathered in March and rubbed together or shaken in bags till the farina separates. It is known as *kapli* or *kaméla* powder." "The powder is much adulterated in our bazárs, but some collected carefully by the Forest Department realised a high price in the English markets". McCann gives (*Dyes and Tans of Bengal*, 18) the facts communicated regarding the dye to the Economic Museum by the various district officers of Bengal. The tree blossoms, he says, in the end of the autumn, and the fruits ripen in January and February. From Bírbhúm the following report was received: "Formerly *kamalágurí* trees grew in abundance in Bhandiban and the adjacent villages; where the weavers were in the habit of paying a certain rent for them, but now they are not taken care of, and the weavers have given up dyeing *tasar* and silk." It would thus appear to have once upon a time been in a state of semi-cultivation in Bírbhúm. In Purí, we are told by McCann, the cost of collection of the powder is

about ₹3 per maund, but in a table the selling price in six districts is shown as varying from ₹7 to ₹40 per maund. McCann then states: "The powder is only very sparingly soluble in either hot or cold water, but is completely dissolved in alkaline liquids, forming a dark red solution. The resinous yellow colouring matter may be separated from this red solution either by neutralising with an acid or else by mere exposure to the air. In Bengal the red powder is dissolved by the addition of a solution of various alkaline ashes obtained by burning plants, and the development of the yellow colouring principle is in no case brought about by the addition of acids, but merely by allowing the cloth steeped in the red liquid to dry by exposure to the air. It is said not to require a mordant, but frequently alum is added for that purpose. The colour is sometimes heightened by the addition of turmeric."

Mr. N. G. Mookerji, in charge of the sericultural operations at Berhampur, Murshidabad (Bengal), stated, in a recent note on a sample of *kaméla* from the forests of the North-Western Provinces which was sent to him for report, that, "though *kaméla* produces a fast colour which arnatto does not, it is being superseded by the latter in Murshidabad—because its colour is brighter and its cost cheaper. The present annual consumption of *kaméla* in the Murshidabad districts is 16 to 20 maunds (1,300 to 1,600lb), and its price is ₹13 to ₹14 per maund. If it could be obtained at ₹10 per maund, dyers might use more of it." A sample of the *kaméla* was sent by Mr. Mookerji to the Director of the Sericultural School at Como, who wrote as follows:—

"I think this colour to be fast and durable, but now-a-days few persons care about the durability, and dyers obtain the same dye with the artificial product called aroflavina, and with much greater facility, *i.e.*, without alum and more rapidly. With the cotton we have had negative results, that is to say, a bad dye. Therefore, considering everything, it seems to me that the *kaméla* cannot have a serious application in the mentioned fibres." In India, at the present day, dyers do not care if a dye is fugitive, provided that it is cheap and bright.

The following note on *kaméla* dye in Ganjam (Madras Presidency) was published in the 'Indian Forester,' 1892:—

"Among the many rich natural products of Ganjam, probably the most esteemed in commerce is the red *kaméla* dye, the valuable product of the *Mallotus philippinensis*. This tree, with its lovely scarlet berries and vivid emerald green foliage, is a marked feature of forest scenery in Ganjam. The berries are coated with a beautiful red powder, which constitutes the dye. This powder is collected by being brushed off into baskets made for the purpose; but the method of collection is reckless and wasteful in the extreme, the trees being often felled in order to reach the berries more easily. The industry is a monopoly of the Hill Khonds, who, however, turn it to little advantage. They are ignorant of the great commercial value of the dye, and part with the powder to the low-country dealers settled amongst them for a few measures of rice or a yard or two of cloth. The industry is capable of great development, and a large fortune awaits the firm or individual with sufficient enterprise to enter into rivalry with the low-country native

dealers settled amongst the Khonds, who at present enjoy a monopoly of the trade. It is notorious that these men are accumulating vast profits in respect of this dye, as they obtain the powder in barter from the Khonds for the most trifling equivalent, and send ship-loads of it from the district. The local native name for the dye is *sundragundi*. The tree is cultivated largely by the Khonds in their forest villages."

SUBSTITUTES.

Atkinson (*Himálayan Districts*, 776) says the substances chiefly used to adulterate the powder are the pounded bark of *Casearia tomentosa* (the *chíla* of Garhwál) and a powder prepared from the red fruits of the banyan tree (*Ficus bengalensis*). On the other hand, he adds, *kaméla* powder is itself used to adulterate arnatto dye. In some districts *kaméla* is always used in combination with arnatto, the one being supposed to strengthen the colour of the other. Wardle, in his recent report on the dyes of India, remarks that the colours produced by *kaméla* are fast. It promises to be a very valuable dye-stuff.

In Calcutta *kaméla* is adulterated with sand. Samples of the powder sold in the Calcutta bazár, and collected in the forests of the North-West Provinces, have been sent to the Imperial Institute for comparison.

EDGAR THURSTON,

Offg. Reporter on Economic Products to the Government of India.

G. I. C. P. O.—No. 26 R. & A. —9-5-93.—1,500.

IMPERIAL INSTITUTE SERIES.

HAND-BOOKS
OF
COMMERCIAL PRODUCTS.

INDIAN SECTION.

No. 17.

GARJAN OR KANYIN OIL
AND
IN OR ENG OIL.

Published under the Authority of the Government of India.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1893.

Price Three Pence.

PREFACE.

The Government of India have arranged to provide to the Imperial Institute for the illustration of the Economic Products of India—

(A) a descriptive Catalogue or Dictionary;

(B) an index collection of all products;

(C) a commercial collection of special products;

(D) a hand-book descriptive of C.

A.—The descriptive Catalogue has been completed, and is termed the "Dictionary of the Economic Products of India." The compilation has occupied eight years, and has been made under the Editorship of Dr. G. Watt, C.I.E., Reporter on Economic Products to the Government of India. It has been confined to the collation of facts and statistics available up to the date of the publication of the work.

To each product there is assigned in the Dictionary a separate number, which will be permanently maintained for purposes of reference.

B.—The index collection will, when completed, be comprised of small samples of every economic product of India, which will bear the same numbers as those assigned to the products in the Dictionary.

C.—The commercial collections are on a larger scale. The number of products of which a collection is provided each year will be limited to about twenty.

Each collection will comprise as complete a set of specimens of the product in its raw and manufactured state as is necessary for the fulfilment of the object with which the commercial collections and hand-books are provided.

D.—The hand-books will supply, in a separate pamphlet for each product, the information contained in the Dictionary, amplified by supplementary facts and statistics, and illustrated by maps, diagrams, photographs, etc.

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E. C. BUCK,

Secy. to the Govt. of India,
Dept. of Revenue and Agriculture

April 10th, 1893.

[These products are described in Dr. Watt's Dictionary of Economic Products, Vol. III, D. 701—720 and D. 696—700.]

GARJAN OR KANYIN OIL.

In this hand-book the articles in the Dictionary of Economic Products by Dr. G. Watt have been reproduced with additions. Its main object is to draw attention to Garjan oil, which is used (I) in the treatment of leprosy and other diseases, and which might, (II) if a process of drying it quickly could be discovered, come largely into use in Europe as a varnish, and might also be utilised (III) as a solvent of caoutchouc and (IV) in the manufacture of water-proof cloth.

OLEO-RESIN.

Considerable confusion exists in the literature of garjan and wood-oil. Apparently several species of *Dipterocarpus* yield balsamic products, to which it would seem the name garjan oil is assigned. In Burma one set of oils is, however, collectively spoken of as Kanyin-oils, another as In-oils. The term garjan appears to be unknown to the Burmans.

In the Dictionary of Economic Products Kanyin oil is described under the heading *Dipterocarpus turbinatus*, Gærtner, which species is regarded, in the 'Flora of British India', as synonymous with *D. lævis*, Hamilton. As regards the synonymy, Dr. George King, Superintendent, Calcutta Botanical Gardens, writes to the editor as follows: "In the 'Flora of British India' there is included under the species *D. turbinatus*, Gærtn. f., the tree named *D. lævis* by Buchanan-Hamilton in the Memoirs of the Wernerian Society, Vol. VI, p. 299. Hamilton distinguishes his species *D. lævis* by its flattened branchlets and perfectly glabrous leaves and petioles; while *D. tuberculatus*, Gærtn., has terete branches and pubescent leaves and petioles. The former (called *dulia garjan* by the natives of Chittagong) yields, he says, no wood-oil; while the latter (called *telia garjan*) does. The materials before me do not enable me to differentiate the two as species. Moreover, specimens sent by you (and which had been collected by the Forest Officer of Chittagong, under the vernacular names *dolia* and *telia garjan*) appear to be exactly alike. Careful investigation in the field may, however, prove that there is some better basis for Hamilton's view than the trifling differences which he has noted in the outline of the branchlets and the pubescence of the leaves."

A reference was made by the Revenue and Agricultural Department to the Government of Burma for particulars, to be inserted in

the Dictionary of Economic Products, as to the various species of *Dipterocarpus* that yield wood-oil (garjan), and the following instructive reply was received:—"Kanyin oil is the produce of *D. lævis* (*kanyin-ni*= red kanyin) and *D. alatus* (*kanyin-byu*=white kanyin) which are common in evergreen forests, and probably of other species of similar habitat. The oil is generally collected only in the dry weather (November to May). It is obtained by cutting two or three deep pyramidal hollows (the apex pointing towards the interior of the stem) near the foot of the tree, and by applying fire to the upper cut surfaces. The oil then collects at the bottom of the hollow, which is emptied every three or four days. Fire is applied every time the oil is removed, and the upper surfaces of the hollow are re-chipped three or four times during the season. In the Tharrawaddy district, where trees are not very plentiful, twenty are about as many as one man can attend to. The yield of twenty trees would be about 100 viss for the season, worth R25. In the Prome district oil only comes into the market in the form of torches, which are made of rotten wood steeped in oil and rolled up in *salu* leaves (*Licuala peltata*). The exports of kanyin oil from Burma ports during 1887-88 were as follows:—

			R
Rangoon	18,826 gallons	valued at	16,302
Moulmein	782 „	„	575
Mergui	55,470 viss	„	9,394

The exports of torches were:—

			R
Tavoy	2,000	valued at	30
Mergui	850,225	„	22,372

"Collectors do not keep the oil from the different kinds of kanyin trees separate, so that the oil which comes into the market is the produce of different species mixed in varying proportions. The Mergui kanyin tree seldom exceeds 6 feet in girth, and is probably distinct from the species found in Pegu and North Tenasserim, which commonly attains a girth of from 15 to 25 feet."

Two other communications, procured through the circular letter alluded to above, may be here published. The Conservator of Forests in Bengal reported: "*Dipterocarpus turbinatus*, the *teli-gurjun* of Bengali, is found in the Chittagong District. It is prohibited to tap in the Collectorate owing to the large number of trees already killed by tapping. This prohibition does not extend to the Hill Tracts. As much of the oil exported from the hill tracts is shoulder-borne, the total amount exported cannot be definitely stated. But the total amount carried past the revenue stations, and which paid a royalty of 10 per cent. *ad valorem* from 1883-84 to 1887-88 may be said to have been as follows: 1883-84, 355 maunds, 1884-85, 125 maunds, 1885-86, 96 maunds, 1886-87, 60 maunds, and 1887-88, 51 maunds.

"The mode of tapping is to cut a deep hollow in the tree, and keep live charcoal in it at night. The oil is removed in the morning, fresh live charcoal put in again at night. It is repeated to flow. Three, four, or more such deep holes in the same tree, with the not surprising result that the falling-off in exports is most probably due to trees already killed by the tapping." A sketch [illegible]

above report, in which the notch made in the trees was shown to be the same as that made in Burma. In this way a cavity is formed with a flat bottom, on which it would be possible to deposit live charcoal, but it may here be added that in Burma charcoal does not appear to be used.

The other communication was from the Conservator of Forests, Coorg, which gives an account of the wood-oil prepared in that portion of the west coast of Southern India. The Conservator writes: "We have two oil trees in the Western Ghat Forests of Coorg. Both, I believe, are species of *Dipterocarpus*, but I have not been able to get the flowers to identify them. The oil is contained in the pores of the wood, and is collected by cutting a hole into the centre of the tree. One species yields a yellow oil, and the other a dark red. The former is sold in the bazaars mixed with dammar (the produce of *Vateria indica*) as varnish at 5 annas a bottle. The latter also makes a fair varnish. It has a strong copaiba-like smell, and would probably be useful in medicine."

More recently the Deputy Conservator of Forests, Coorg, wrote to the effect that "practically nothing is known of the oil of *Dipterocarpus lævis* (the species in Coorg) in the local markets. The tree is locally known as the *yenni mara* (oil tree) or *balúti mara* (large tree), but there is no regular collection of the oil. What is sold in the Mercara bazár as wood-oil is said by the sellers to come from Madras, and this I am inclined to believe, for the minor forest products of Coorg are almost unknown."

Gamble points out that, according to the 'Flora of British India', *D. indicus*, Beddome, may be reduced to either *D. turbinatus* or *D. lævis*. He appears, however, to view it as a distinct species, a native of the Western Ghats, which is there known as *guga* and *walivara* in Kanarese. The garjan oil reported to be made in South India would, accordingly, be the product of *D indicus*.

During a conversation on this subject with the writer, Mr. Ribbentrop remarked that it was impossible to mistake the trees that yield Kanyin and In oils. *D. tuberculatus*, the In, was a low growing tree found only on the *indaing* soils, and forming dense forests somewhat like its associate the *Sál* (*Shorea robusta*.) This was in his opinion the chief if not sole source of the oil which was collected in the autumn and cold season, flowing from a wound without the aid of fire. The other trees alluded to were *D. turbinatus*, *D. lævis*, and *D. alatus*. These are very lofty, occur in mixed forests, and tower above the surrounding trees. They frequent deep rich soils, and yield in spring their oleaginous products on being charred. Mr. Ribbentrop regards *D. lævis* as distinct from *D. turbinatus*; the former being a much loftier tree than the latter. Kurz mainly distinguishes these plants by the former being glabrous, while the latter is hairy.

The following notes were recently submitted by the Conservator of Forests, Upper Burma, and the Deputy Conservators of Forests, Chittagong and the Andaman Islands, in connection with collections made for the Imperial Institute.

[redacted] *Upper Burma.*

[redacted]ious species of *Dipterocarpus*) occurs [redacted] this [redacted] upper part of the Chindwin river, where the

forests appear to approximate to those of Tenasserim and the Andamans, the rainfall being very considerable. The forests in which it occurs have rarely, if ever, been visited by European Forest Officers or even subordinate Forest Officers. For working kanyin oil the following licenses have been issued during the last three years in the Chindwin division :—

1889-90	2 licenses.
1890-91	4 „
1891-92	73 „

The following report was recently drawn up by Mr. W. A. Hearsey, Assistant Conservator of Forests, Shwegu Sub-division :—

Mr. Hearsey went, early in April, 1893, to the Hwehu Forest, 5 miles south of Shwegu, to select kanyin trees (*kanyin ni*) for tapping.

The trees were found growing in clumps, in hollows and ravines, chiefly near water, in a mixed forest of Teak and In.

Eleven trees, varying from 7′7″ girth and 74′ height to 21′9″ girth and 180′ height, were selected. These trees had clean boles up to a good height, and the depth of the crowns was about a fifth of their whole height.

Of the 11 trees which were tapped, 10 were fired, and only 8 gave any result, the total yield being 27 quart bottles of oil, mixed with a thick whitish-coloured resin. One tree, growing in the shade surrounded by thick undergrowth, yielded no oil or resin at all. Two blazes were made in the largest tree, and 1½ quart bottles of oil obtained.

The blaze is usually made at a height of about 4 feet from the ground on the side most exposed to the sun. It is concave, and the bottom is scooped out to a depth of about 12″ to retain the oil. The width of the cut varies from 1′6″ to 2′, and the height from 12″ to 18″ according to the size of the tree. After the blaze is completed it is filled up with dry leaves and grass, which are set on fire. The fire is allowed to burn for about a quarter of an hour, and is then put out. The oil commences to flow immediately, and when the flow decreases owing to the pores getting blocked up, the blazes are cut afresh, and the firing operation is repeated. The blazed trees were fired four or five times, or about once in ten days. The oil is collected every three or four days.

Mr. Hearsey found that trees growing amidst a dense undergrowth, the boles of which are shaded from the direct rays of the sun, yield a very small quantity of oil as compared with those growing singly, and exposed to the full benefit of the noon-day sun. Three of the trees growing in heavy shade, which were tapped, yielded only 4 quart bottles of oil. One tree which was not fired, but was growing in an exposed spot, yielded 1½ quart bottles of oil. The trees must be fired to obtain a copious flow of oil. Firing does not kill the trees, nor do the leaves wither after firing. The only fear is from jungle fires.

The total quantity of oil collected from 7th April to 26th May was 28½ quart bottles at a cost of R10-8. A[illegible] extracted at a smaller cost.

The kanyin trees are scattered ov[illegible] Sub-division. As far as Mr. Hearsey c[illegible]

extract the oil there for trade purposes, but use it in small quantities medicinally for sores on their buffaloes.

Herbarium specimens sent by Mr. Hearsey have been identified by Dr. G. King as *Dipterocarpus lævis*, Ham.

(*b*) *Chittagong.*

There are three kinds of garjan tree in this division, *viz.* :—

(*a*) Tailia —From this tree oil is obtained, and the leaves are considerably larger than those of either of the other kinds.

(*b*) Bhoita.—From this tree oil is obtained, but it congeals at once. The bark is thick and very white, and the leaves are very small.

(*c*) Dholia —From this tree no oil is obtained. The bark is white, but thinner than that of either of the other two, and the leaves are larger than those of bhoita, but smaller than those of tailia.

All three kinds exude resin. The local method of tapping and obtaining the oil is as follows :—About 3 feet above the ground a cut, about 8 inches in length, is made with an axe parallel to the ground. From about 4 inches above the centre of the cut, and gradually meeting it at its extremities, the bark is peeled off, and a receptacle made, 3 inches in depth, slightly sloping downwards and inwards to admit of the oil depositing itself and being easily collected. The receptacle thus made is singed with a blazing torch, to accelerate the flow of the oil, weekly or bi-weekly, as may be necessary. The trees are tapped after they have attained the age of 20 years. If the trees are tapped before this age, the effect is most deleterious, as is also the case if more than one receptacle is made. Tapping in any case stunts the growth of the tree, and ruins it for timber purposes, as it generally becomes, under these circumstances, more or less hollow.

The tapping of garjan trees is now prohibited throughout the Government Forests in the Collectorate of Chittagong. The quantity of oil available from the Hill Tracts is estimated at 10,000lb per annum.

It is reported that torches are not procurable in this district, but that they are used in Arakan.

Specimens of the leaves of the three kinds of garjan tree referred to above were examined by Dr. George King, who reported that they are "all hairy only on the midrib beneath, and would therefore exactly fit Hamilton's description of *D. lævis*, and Roxburgh's of *D. turbinatus*."

(*c*) *Andamans.*

The field for working is very large, and the large trees are very, very numerous, but the oil is only extracted in small quantities for settlement purposes, and there is no regular trade in it.

The samples of oil sent to the Imperial Institute, which were collected by Burme[redacted]ts, were collected from large trees of two different species of [redacted]*rpus*, viz., *D. Griffithii* and *D. turbinatus* var. *andamanicus*, Ki[redacted]

Varieties of Garjan Oil.

The writer can discover no author who has separately distinguished the oleo-resins described above; indeed, in all the published accounts which he has been able to consult, the substance described appears to be that obtained after charring the trees—the kanyin oils. Thus Roxburgh wrote of *D. turbinatus*, that "To procure the balsam, a large notch is cut into the trunk of the tree near the earth (say, about thirty inches from the ground), where a fire is kept up until the wound is charred, soon after which the liquid begins to ooze out. A small gutter is cut in the wood to conduct the liquid into a vessel placed to receive it. The average produce of the best trees during the season is said to be sometimes forty gallons. It is found necessary, every three or four weeks, to cut off the old charred surface, and burn it afresh; in large healthy trees abounding in balsam, they even cut a second notch in some other part of the tree, and char it as the first. These operations are performed during the months of November, December, January and February. Should any of the trees appear sickly in the following season, one or two more years' respite is given them." Lieut. Hawkes published, in his report on the oils shown at the Madras Exhibition of 1855, an account of the extraction of this oil by charring, the operation being performed in March or April. But Lieut. Hawkes was apparently, like Roxburgh, ignorant of the oil extracted from *D. tuberculatus* with or without the aid of fire. Sir J. D. Hooker (*Him. Journals, Vol. II, 348*) gives a brief note regarding the oleo-resin obtained in Chittagong from *D. turbinatus*.—He says: "A fragrant oil exudes from the trunk, which is extremely valuable as pitch and varnish, etc., besides being a good medicine. The natives procure it by cutting transverse holes in the trunk, pointing downwards, and lighting fires in them, which causes the oil to flow." Mason, than whom few more trustworthy authors on Burmese subjects could be found, attributes wood-oil to *D. lævis* and *D turbinatus*, but says of *D. grandiflora* (a synonym for *D. tuberculatus*) that "the gum of this species, as well as that of the preceding is used by the natives to make torches." It is, however, significant that Mason should not have described the process of extraction of his "wood-oil" or of the "gum," or even mentioned the seasons at which these products are obtained. Dr. Cooke, in his report on the Gums, Resins, and Oleo-resins of India, quotes Roxburgh's description of the process of extraction, and reviews the opinions advanced by Lieut. Hawkes under *D. turbinatus, Gærtn. f.;* but under *D. tuberculatus Roxb.*, he simply remarks: "A wood-oil, under the name of Eng is said to be the produce of *D. tuberculatus*; this was sent to London from Burma (May, 1874) for valuation and report." Flückiger and Hanbury (in their *Pharmacographia*) follow the same course, but seem not to have heard of an oil extracted without the aid of fire, such as the thick oleo-resin known in Burma as In oil.

In a further paragraph will be found the opinions of medical writers regarding garjan oil, in which it is held that there are different qualities, some of very considerably higher medicinal than others. This fact would point to the desirability of a thorough investigation into the

oleo-resins obtained from all the species of *Dipterocarpus*, in which the chemical properties and industrial merits of each should be separately established. With this in view experiments might be conducted in order to ascertain if *D. tuberculatus* is the only species that affords the oil on being simply tapped, or whether *D. turbinatus* and *D. lævis* might not also do so, and lastly what action or influence the charring process exercises.

It seems probable that, assuming that the oleo-resins from all the species of *Dipterocarpus* are chemically identical, that obtained during a different season of the year, and by a different process, may be distinct or have its properties changed from what might be called the normal secretion of the *Dipterocarpi*. In concluding this brief review of the literature of garjan oil, it may be as well to point out that, according to the report above, the kanyin oil (or that produced by charring the trees) comes into the market mainly as torches. From this fact the inference might be deduced that the garjan oil of commerce was obtained from *D. tuberculatus*, and not from *D. turbinatus* and *D. lævis*, the species to which the oil has hitherto been attributed. The writer must, however, suggest caution in accepting this inference, but it may safely be assumed that at least the thick honey-like form of garjan oil is the In oil of Burma.

Chemical Properties of Garjan Oil.

Lieut. Hawkes (in his report on the oils shown at the Madras Exhibition) says that this class of substances, called wood oils, forms the connecting link between the oils and resins of the vegetable kingdom. They consist of a volatile oil holding in solution a resin, and are generally classed under the head of balsams. It is commonly stated that the oil, if set aside for a time, subsides into two substances, *viz.*, a clear thin liquid, floating above a thick mass known as guad. One of the most remarkable properties attributed to this oil is the fact that it is reported to act as a solvent to caoutchouc. This was apparently discovered at the beginning of the present century by Mr. Laidlay, and his experiments will be found in the *Transactions of the Agri-Horticultural Society of India* (*Vol. VIII, 345*); also reproduced in Mason's *Burma*. Mr. Laidlay directs that the caoutchouc should be dropped into the garjan oil in small pieces. In a few hours it swells, and must then be frequently stirred to facilitate the process. If heat be applied, complete solution is speedily effected. The solution obtained may be spread on cloth, which is said to be thus rendered waterproof. This fact appears to have been practically lost sight of, while it might prove the key to an industrial utilisation of the substance, since such water proofings would, from the property of the garjan oil, be at least proof against the attacks of insects, if they were not found in addition to possess other useful properties.

A sample of garjan oil obtained from Moulmein was examined by Flückiger and Hanbury. Space cannot be here afforded to reproduce their report on the substance. The reader is referred to their *Pharmacographia*, p. 88, or to Dr. Dymock's *Materia Medica of Western India*, where, however, the account of the chemistry of this substance, as given by the authors of the *Pharmacographia*, is reproduced. By simple distillation with water they obtained 37 per cent. of an essential oil, leaving in

the still a dark viscid liquid resin. The sp. gr. of this essential oil was found by Flückiger and Hanbury to be 0·915, but by O'Shaughnessy it is given as 0·931, and by De Vry as 0·928. One of the most remarkable physical properties of this oil is the fact that at a temperature of 130°C. it becomes gelatinous, and on cooling does not recover its fluidity. The learned authors of the *Pharmacographia* found the resin to contain, like that of copaiba, a small proportion of a crystallisable acid, which may be removed by warming it with ammonia in weak alcohol. The portion of the resin which they found to be insoluble, even in absolute alcohol, was uncrystallisable. Werner, however, found a sample of garjan oil examined by him (as well as its resin) to be entirely soluble in boiling potash lye. The crystallisable acid extracted from the resin Werner called gurjanic acid (C_{44} H_{68} O_8) : it is soluble in alcohol 0·838, but not in weaker. It is dissolved also by ether, benzol, or sulphide of carbon. The amorphous resin, which forms the chief bulk of the substance obtained after the removal of the essential oil, has not as yet been definitely analysed. Flückiger and Hanbury found, however, that after complete desiccation it was not soluble in absolute alcohol. These authors add that a sample of garjan balsam of unknown origin yielded a crystallisable substance answering to C_{28} H_{46} O_2 : and this was devoid of acid character. They would thus appear to have inferred that the garjan oil of commerce is not a substance of uniform chemical character; hence they conclude by recommending that "a comparative examination of the product of each of the above named species of *Dipterocarpus* would be highly desirable." Dr. Dymock, while not materially enriching the chemical knowledge of this substance, gives much interesting information as to the medical opinion held regarding the properties of the drug. The admission of different chemical and medicinal results confirms to a large extent the contention advanced in this work, *viz.*, that there are at least two widely different substances sold in the markets of India under the name of Garjan oil, the Kanyin, and In Oils of Burma.

Tests for Garjan, Copaiba, and Hardwickia Balsams.—Dr. Watson says: "Its entire solubility in coal naphtha proves the absence of any of the soft resin which exists in most of the copaiba of commerce." It may be distinguished from copaiba or the balsam of *Hardwickia* thus: shake up 1 drop of the balsam with 19 of carbon bisulphide, add one drop of nitro-sulphuric acid and agitate. Copaiba will show faint reddish-brown with a deposit of resin on the sides of the tube: garjan, intense purplish-red, soon becoming violet: while *Hardwickia* will not alter from its pale greenish yellow.

Trade in Garjan or Wood-oil.

The above special reports regarding the garjan oil of Burma and Chittagong make the usual admission that, owing to the cheap price of kerosine, the trade in wood-oil has very considerably declined. It is now mainly used for torches and in waterproofing, etc. The trade in the medicinal garjan oil must be very limited indeed. It appears to be mainly obtained from the Andaman Islands, and to be the produce of *D. alatus*, and possibly *D. turbinatus*.

Flückiger and Hanbury (*l. c.*) state that the world's supply is

obtained from "Singapore, Moulmein, Akyab, and the Malayan Peninsula, and that it is a common article of trade in Siam." (*Conf.* with Mr. Oliver's opinion above as to the plant which yields the Tenasserim oil.) "It is likewise produced in Canara in South India." "It is occasionally shipped to Europe." The Burma oil is most probably obtained from *D. turbinatus* and *D. alatus* (*Kanyin*) and from *D. tuberculatus* (*In*). Dr. Dymock remarks: "Garjan balsam is not an article of commerce in Bombay; small quantities may be sometimes obtained in the native drug-shops. The Government supplies have been obtained from the Andaman Islands." The late Dr. Moodeen Sheriff (in his work on the Materia Medica of South India) says that in Madras "wood-oil is pretty common in most large bazárs."

He describes several forms and gives their prices:—"Of the black or dark brown variety—wholesale, R12 per maund; retail or bazár, annas 10 per pound. Of the red or reddish-brown variety—wholesale, R24 per maund; retail or bazar, R1-4 per pound. Of the pale white or grey variety—wholesale, R18 per maund; retail or bazár, R1 per pound." He adds: "There are several varieties of garjan or wood-oil, but out of these, three are generally met with in the bazárs, which are known as *suféd garjan-ká-tél* or *suféd lakrí-ká-tél* (the pale white or grey variety), *lál garjan-ká-tél* or *lál lakrí-ká-tél* (the red or reddish-brown variety) and *kálá garjan-ká-tél* or *kálá lakrí-ká-tél* (the black or dark-brown variety)."

Fully fifty years ago hopes were entertained that garjan oil would become an article of European trade, meeting a demand in the arts. Dr. Royle wrote on this subject, and a member of the Agri-Horticultural Society of India consigned five hundred gallons to London. The effort proved futile, as Dr. Royle reports, because the Custom-house officers refused to pass it except at the highest rate of duty, namely, that for a manufactured article. It seems probable that this obstruction prevented the industrial enterprise of the British manufacturer from being able to discover a use for an article which has in consequence remained at a nominal value.

Medicinal uses of Garjan Oil.

Garjan balsam does not appear to have been used medicinally by the early Hindus. It does not bear any Sanskrit, Arabic, or Persian names. In Muhammadan works on Materia Medica it is first mentioned in the *Makhzan* under the name of *duhn-el-garjan*. Ainslie was the earliest European medical writer to mention it, and that in his *Materia Medica of Hindustan*—a work published in 1813. A prior notice occurs, however, in a work by Francklin (*Tracts on the Dominions of Ava, p. 26*) published in 1811. But Ainslie does not seem to have continued to value the drug, since in his larger and final work—the *Materia Indica*, published in 1836—he makes no mention of it. Sir William O'Shaughnessy in 1841 (*Bengal Dispensatory, 222*) recommended the balsam to the consideration of European physicians. He wrote: "The garjan balsam varies in consistence from that of a thick honey to a light oily liquid. The colour of a fine specimen of thick garjan obtained from Captain Jenkins of Assam was pale grey; specimens sent from Ran[illegible]

by Mr. Speir were a light brown. As found in the bazar, this substance generally occurs as a brown oily-looking, semi-transparent liquid, in odour strongly resembling a mixture of balsam of copaiba with a small portion of naphtha." After giving the results of his chemical examination or division of the substance into its essential oil and resin, he continues:—"The close resemblance in the chemical properties of this garjan and copaiba balsam led to the institution of an extensive set of experiments on the medicinal effects of the former in the treatment of gonorrhœa. The results, which have been laid before the profession, and which have been confirmed by trials made by other practitioners, seem perfectly conclusive that in the treatment of gonorrhœa, gleet, and similar affections of the urinary organs, the essential oil of garjan is nearly equal inefficacy to the South American drug. The essential oil may be given in 10 to 30 drop doses in mucilage, milk, rice-water, or thin gruel, and repeated thrice or still more frequently daily. It generally causes a sensation of warmth at the epigastrium, eructations, and sometimes slight purging. It communicates a strong smell of turpentine to the urine, which it increases remarkably in quantity. Some obstinate cases of chronic gonorrhœa and gleet, which had long resisted copaiba and cubebs, have been cured by this remedy in the course of the experiments alluded to." "In the *Pharmacopœia* we have given a formula for a solution of the essential oils of garjan and cubebs in sulphuric ether, which affords a cheap but perfectly efficacious substitute for the celebrated 'Frank's Specific'."

Pursuing, in order of publication, the Indian works which treat of this substance, the *Pharmacopœia of India* in 1868 made it officinal. It is in that work described as a "stimulant of mucous surfaces, particularly that of the genito-urinary system, diuretic," and in a further page the results of various experiments with this substitute for copaiba are given. Dr. T. B. Henderson of Glasgow is said to have used it only when copaiba failed, and with remarkably good results. Dr. H. B. Montgomery found that it is apt to produce "an eruption of a character similar to that occasionally following the use of copaiba." Dr. Kanny Lall Dey, C.I.E. (*Indigenous Drugs of India, p. 51*), republishes the facts given above regarding the use of the drug in the treatment of gonorrhœa, but adds that "it is also used externally as a stimulating application to indolent ulcers." Waring (*Bazar Medicines, p. 56*) says it has the odour and taste of copaiba, but is less powerful. "It has been used as a substitute for this latter drug in the treatment of gonorrhœa, and trials with it in the hands of Europeans have shown that it is a remedy of no mean value in that affection. It is only advisable in the advanced stages, or when the disease has degenerated into gleet. In the latter affection it is stated to prove most useful. It is also well worthy of a trial in leucorrhœa and other vaginal discharges." Dr. Waring then proceeds to say that "great success has been found to attend its employment, both internally and externally, in the treatment of leprosy." He then quotes Dr. J. Dougall's proposed treatment for leprosy (*Indian Medical Gazette, February 2nd and March 2nd, 1874*) as follows: "Rise at day-light and wash the body thoroughly, using dry earth as a detergent, in which cha[illegible]ter it is more efficient than soap or bran. After this is completed, at [illegible] a dose of the emulsion is given, and for the next two hours the

patient himself should perseveringly rub in the ointment over his whole body This is a point of importance, not merely smearing it in here and there, but using thorough and continuous friction over the whole surface for a couple of hours. This prolonged rubbing is not only insisted upon for the sake of the action of the ointment upon the skin, but because it is considered that any gentle employment, combined with exercise, proves beneficial both physically and mentally. After this inunction, breakfast may be taken, and some light employment followed during the day. At 3 P.M., a second dose of the emulsion is given, followed by another two hours' friction. Should the emulsion act too freely on the bowels, the dose should be diminished. In none of the cases treated by Dr. Dougall was there any change from the ordinary native diet, but we may reasonably expect even better results where a liberal supply of good and nourishing food is allowed. The success which has attended this treatment is very marked and encouraging and is fully confirmed by Dr. A. S. Lethbridge." (*Indian Medical Gazette, 1st July, 1874.*)

On the other hand, Dr. Dymock says of Dr. Dougall's reported success in the treatment of leprosy : "In order to test the correctness of this statement, large quantities of the balsam have been distributed by the Indian Government, but as far as I have heard the new treatment is not likely to prove successful. Dr. Dougall's directions for carrying out the treatment of leprosy by garjan balsam include frequent ablutions with dry earth and water, and strict attention to the hygienic condition of the patient; it seems probable that he has attributed effects to the balsam which are in reality due to cleanliness and an improved hygienic condition. Within the last two years several tons of the drug have been distributed in the Bombay Presidency."

Dr. Moodeen Sheriff, the most recent writer on the subject of the properties of garjan balsam, says.: "All the varieties of garjan oil are equally useful as a local stimulant, but the red or reddish-brown and the pale-white or grey varieties are the best for internal use. The best medical properties of this oil are its usefulness in gonorrhœa and gleet, and in all forms of psoriasis, including lepra vulgaris. In gonorrhœa and gleet it is at least equal to copaiba, and the only difference between these two drugs is that the former requires to be used in a much larger dose (2 drachms to 3 drachms) to produce the same effect as the latter. As garjan balsam is always used in the shape of emulsion with mucilage, the largeness of its dose is no disadvantage. With regard to its usefulness in psoriasis and lepra vulgaris, I am not aware of any other local stimulant which is more efficacious in those diseases than this drug. I have either cured or relieved many cases of the above affections by the use of this drug with little or no assistance of internal remedies. The internal use of wood-oil is also attended with benefit in some cases of true leprosy in its early stage; but its efficacy in this respect is greatly enhanced with the addition of from five to ten drops of chaulmugra-oil to each drachm of it. If well mixed in the above proportions, the combination of chaulmugra-oil cannot be detected. Some years ago I received a bottle of gurjan-oil of this kind from a medical friend, which proved itself more useful in a case of true leprosy than all its varieties in the bazaar, but I did not know the existence of chaulmugra-oil in it until I was informed of it." Martindale and Westcott say: " It is

very florescent, has an opaque, dingy, greenish grey colour seen by reflected light, yet is transparent and reddish-brown in strong day-light; it has the weak aromatic odour and bitterish aromatic taste of copaiba without the acridity—has been used as an adulterant of copaiba. It is not completely soluble in either ether or alcohol; emulsified with mucilage of *Acacia*, it is used with success like alcohol; for gonorrhœa and, in the East, as a remedy for leprosy, an emulsion is made of equal parts of the balsam and lime water, which is used freely as a liniment and given to the extent of 4 drachms three times daily."

SPECIAL OPINIONS.—"Very effectual in relieving true leprosy. Dose internally as in the *Pharm. Ind.*; for an ointment take of the oil 1 part, lime water 3 parts; useful for chronic skin diseases and true leprosy." (*Apothecary, Madnapalle, Cuddapah.*) "Garjan oil is of undoubted efficacy in tuberculous leprosy." (*Civil Surgeon R. D. Murray, Burdwan.*) "Very useful in cases of leprosy. Externally the oil should be well rubbed into the affected parts. Internally it is taken in doses of 3 drachms or 1 drachm mixed with lime water or Liq. Potassæ." (*Civil Surgeon J. Anderson, Biinor.*) "I have tried it frequently in cases of leprosy; it is a good dressing, and heals the ulcers as well as if not better than any other application, and the inunction of the oil does the sufferer good constitutionally, but it is certainly not a specific for leprosy, nor does it stop the nerve disease." (*Surgeon-Major C. W. Calthrop, 4th Bengal Cavalry, Morar.*) "The oil with a little corrosive sublimate and sulphur is a capital remedy for ringworm." (*Surgeon-Major P. N. Mookerji, Cuttack, Orissa.*) "I used this oil for two years in the treatment of leprosy, but found it perfectly useless." (*Brigade Surgeon C. Joyut, Poona.*) "*Gurjun tél*,—The Andaman oil is the best, and useful in leprosy. Taken internally and applied externally too." (*Civil Surgeon C. M. Russel, Sarun.*) "Is a good dispensary substitute for copaiba in gonorrhœa and mucous discharges. Its internal and outward use in leprosy is highly recommended". (*Dr. Picachy, Civil Medical Officer, Purneah.*) "I experimented for two years with garjan oil as a cure for leprosy in the lepra ward at Burdwan in 1875-76-77. It is useless as a specific, which it was claimed to be, but the ointment is a fairly good application for leprous and other ulcers." (*Civil Surgeon C. H. Joubert, Darjeeling, Bengal*) "The balsamic exudation of *D. turbinatus* or garjan balsam is a very valuable external and internal stimulant. It exercises more or less beneficial influence over all skin diseases, but its curative effect in those of a scaly nature as lepra vulgaris and psoriasis is highly satisfactory. Many a case of the last-named disease has been relieved by its external use with little or no assistance of internal remedies. I have also employed it pretty extensively in the cure of gonorrhœa, and quite agree with what is already mentioned on this point. There are several varieties of garjan balsam, but the thin and reddish brown variety is about the best." (*Honorary Surgeon Moodeen Sheriff, Khan Bahadur, Triplicane, Madras.*) "Useful application in scabies. It did not prove so useful in my hands in gonorrhœa when administered alone." (*Assistant Surgeon Shib Chundra Bhattacharji, Chanda, Central Provinces.*) "Recently much praised as a cure for leprosy. I have not been able to obtain any remarkable effects from its use." (*Civil Surgeon G. Price, Shâhabad.*) "The oil prepared

into an ointment for external application, and given internally in leprosy in early stage of the disease, undoubtedly arrests further progress, and affords great relief in advanced cases. The ointment is prepared by mixing the oil with lime water in equal parts, and churning it into a creamy substance. It should be well rubbed into the affected parts, for at least 15 minutes, every morning and evening. The oil given internally from one to ten drops, morning and night, in cold water." (*Civil Surgeon S. M. Shircore, Moorshedabad.*) "Garjan oil was used extensively at the penal settlement of the Andamans in the treatment of leprosy. After long trial it was found to act beneficially in many cases as a palliative remedy, but as a specific for the cure of leprosy it completely failed." (*J. Reid, Principal Medical Store-keeper to Government, Fort William.*)

After reviewing the various trials which have been made with garjan oil, the Leprosy Commission, 1890-91, in their recently issued Report, state that "it appears that, though a certain amount of temporary relief may follow its use, it is very doubtful whether this is more than can be obtained with any common oil. Dr. Dougall's success at Port Blair was probably due to the fact that he was dealing with a colony of convict lepers under prison treatment, and was therefore able to carry out his plan of treatment for more rigorously than in an asylum where, as a rule, patients are averse to any therapeutic measures which involve the least exertion. It is quite possible that the prolonged frictions with dry earth, and the regular sea bathing, were quite as potent in affording relief as the use of the garjan oil."

Domestic and Industrial Uses of Garjan oil.

It is extensively employed by the Burmans as torches, but now-a-days it is only used to a limited extent as a lamp oil. It is largely employed in preserving bamboo wicker-work from the attacks of insects and in paving the bottoms of boats. It is also used as a varnish. It is reported to be useful as an ingredient in lithographic ink. In European medicine it is mainly utilised as an adulterant for copaiba. But it is commonly held that, if a process could be discovered of causing it to dry more rapidly, it would come largely into European use as a varnish. It has been suggested that this might be effected by mixing it with some good drying oil, or by evaporating away the essential oil. It seems to the writer, however, that a far more important way of utilising the article might be found in taking advantage of Mr. Laidlay's discovery that it acts as a solvent of caoutchouc. A thick coating of India-rubber is of course perfectly water-proof, but the way in which India-rubber sheetings, overcoats, etc., harden, dry, and crack at one season of the year or stick together at another under the tropical climate of India, would recommend the experiment being made to ascertain if this would be also the case with a water-proofing material made of a solution of India-rubber in garjan oil. The merits of garjan oil have at all events not received sufficient attention by the manufacturer, and Sir William O'Shaughnessy's opinion may be here quoted in favour of the desirability of the matter being looked into in the future. Sir William wrote fifty years ago that garjan was "likely to be found a perfect substitute in the arts

for the expensive balsam of copaiba, now much used in the preparation of colourless varnishes and drying paints. In the coarser kinds of house and ship painting, garjan balsam is used as an excellent substitute for linseed oil." Dr. Wight also speaks highly of the property of garjan in preserving wood, etc., from the attacks of insects ; its defects are slowness of drying, thin body when dry, and liability to being brittle.

IN OR ENG OIL.

Dipterocarpus tuberculatus, *Roxb.*

ENG OR IN TREE.

Syn.—D. GRANDIFLORUS, *Wall.*

Vern.—*Eng* or *In*, BURM.; *Soahn*, TALEING.

Habitat.—A large, deciduous, gregarious tree, forming the In Forests of Burma and Chittagong. Distributed to Siam.

OLEO-RESIN.

According to Roxburgh, Gamble, Kurz and other authors, this tree does not yield a wood-oil, but exudes a clear yellow resin. Mr. J. W. Oliver, Deputy Conservator of Forests, informed Dr. Watt, however, that it does yield an oil, but of considerably thicker subsistence (an oleo-resin) than the kanyin oils described under *D. turbinatus*. "In oil," Mr. Oliver says, "is the product of *D. tuberculatus* (Burmese *In* or *Inma*—female *In*), and is always found on laterite, gravel or clay, very often forming pure forests. The process of extraction practised in the Prome and Tharawaddy districts is as follows: A deep semicircular niche, with a convex roof, is made through the sap-wood near the foot of the tree, extending round one-third of its circumference, with a hollow in the lower portion of the cut to receive the oil. After a few days the oil is collected, and the wood on the upper surface of the incision chipped away so as to expose a fresh surface of sap-wood. This chipping has to be frequently repeated, as the pores of the wood become clogged with congealed oil. In many cases fire is also applied to the cut, but this appears to be not absolutely necessary. The object of firing is probably the same as that of chipping, *viz.*, to remove the congealed oil. The latter is very inflammable, and the cut surface invariably gets burned during the jungle fires, whether fire is used in collection or not, so that between chipping and burning a wound, some 6 feet long by 2 feet wide, is formed in the side of the tree. The tree thus gets gradually cut or burned through, and falls over by its own weight. The oil is collected from four to ten times a month. A man and boy can look after about 300 trees, which yield about 20 viss a month. The time of collecting lasts from August to February. At the end of the season the congealed oil or resin which remains in the hollow is scraped off, and used for torches which are made of rotten wood mixed with oil and resin, and rolled up in the leaves of the *satthwa*—a species of screw-pine common along the banks of streams in *In* forests. The oil is also largely used for water-proofing bamboo-baskets, for well-buckets, etc. The selling price of oil in the Prome and Tharawaddy districts in 1882 was 5 to 7 viss for the rupee."

The following notes on the Burmese In oil were recently prepared by the Deputy Conservators of Forests, Pegu Circle and Prome Division.

respectively, in connection with the collections which were made for the Imperial Institute :—

(*a*) *Pegu Circle.*

In the Zamayi range Eng oil is extracted in small quantities for making torches, which, when manufactured, sell at the rate of R4 per 100. The method followed in obtaining the oil is as follows :—

From January to April trees of 6 feet girth and upwards are selected. In these trees, at a height of about 3 feet from the ground, incisions 9 inches to 10 inches deep and about 1 foot wide are made into the heart-wood of the Eng tree. This incision is concave at the bottom, the concavity being large enough to hold from 20 to 50 ticals weight of the oil. The number of incisions varies from one to two in trees of 6 feet girth to 5 in trees of 15 feet girth. The oil is taken out three days after making the incision, and the hole is slightly fired.

After two years, if the upper surface of the incisions is pared, the oil again flows, but, after this has been done once or twice, it would appear that the oil does not exude, or, at least, not in sufficient quantity to make it pay, as fresh incisions are made some feet above the old decayed ones.

From the oil with *Salu* leaves and chopped wood (?) torches are made about 18 inches long and 6 inches in diameter.

(*b*) *Prome Division.*

The In tree forms pure forests by itself, but other trees, such as Thitya and Thitsi, are often found growing in conjunction with it. The extent of almost pure In forests in the Prome District is nearly 100 square miles.

The age of tapping the tree is uncertain, but no trees are tapped before attaining a girth of about 4 feet.

The means employed to get the oil is to make a triangular cut in the tree to a depth of about 6 inches into the heart-wood, forming a kind of well. It is the usual thing for a tapper to make three of such wells in one tree at the same time. Every seven days for about two months he comes and takes away the oil in pots.

At the end of two months he removes to another tree. The only instrument used is a Burmese axe.

The oil, on being taken from the tree, is put in a pot, and about 15 per cent. of earth oil is added. It is then boiled for about an hour, and afterwards allowed to cool: as it cools it hardens and becomes resin.

The resin is used chiefly for caulking boats; otherwise there is not much demand for it. If mixed in the proportion of $\frac{2}{3}$ earth oil and $\frac{1}{3}$ In oil, the compound is used to spread on Burmese umbrellas to render them water-tight.

A man working for a year (and resin can be obtained all the year round) gets about 200 viss of resin, which is sold at Prome at about 6 annas a viss. About 1,500 viss of resin are sold in Prome in a year.

EDGAR THURSTON,
Offg. Reporter on Economic Products
to the Government of India.

IMPERIAL INSTITUTE SERIES.

HAND-BOOKS

OF

COMMERCIAL PRODUCTS.

INDIAN SECTION.

No. 18.

JALAP.

Published under the Authority of the Government of India.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1893.

Price one Penny.

PREFACE.

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(B) an index collection of all products;

(C) a commercial collection of special products;

(D) a hand-book descriptive of C.

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E. C. BUCK,

Secy. to the Govt. of India,
Dept. of Revenue and Agriculture.

[This product is described in Dr. Watt's Dictionary of Economic Products, Vol. IV., I. 401—404.]

JALAP

In this hand-book the article in the Dictionary of Economic Products by Dr. G. Watt has been reproduced with additions. Its object is to draw attention in Europe to the cultivation of Jalap on the Nilgiri Hills in Southern India and on the North-Western Himálayas at Mussoorie.

Ipomæa purga, *Hayne.*

JALAP.

Syn.—EXOGONIUM PURGA, *Benth.*

Habitat.—This Convolvulaceous plant is a native of the Mexican Andes, occurring at altitudes between 5,000 and 8,000 feet above the sea. In the localities where it occurs rain falls almost daily, and the diurnal temperature varies from 60° to 75° Fh. It flourishes in shady woods in a deep rich vegetable soil.

It is now being cultivated in Europe and India. In the south of England it is said to grow freely if planted in sheltered borders; but its flowers are produced so late in autumn that they rarely expand, and the tubers, which develop in some abundance, are liable to be destroyed in winter, unless protected from frost (*Pharmacographia*).

N.-W. PROVINCES.

About the beginning of the present century, Ainslie urged that the Government of India should endeavour to cultivate the jalap plant. In 1836, the same recommendation was made by Dr. Royle, but apparently the first attempt at its cultivation was not made until in 1854. Dr. Jamieson, Superintendent of the Botanic Gardens, Saháranpur, in that year reported:—"Through the kindness of Dr. Royle I have been able to introduce jalap into the Himálaya, where it is now growing with great vigour. In a few years there will be a sufficient quantity of roots to supply this valuable medicine to the public service. It grows well at altitudes between 4,000 to 4,500 feet." Commenting on that report Mr. J. F. Duthie informs the author that "this experiment did not lead to any practical result, as no further mention was made by Dr. Jamieson regarding the cultivation of the plant."

For the following note on the cultivation of jalap at the hill-station of Mussoorie the writer is indebted to Mr. W. Gollan, the present Superintendent of the Saháranpur Gardens:—

"This valuable medicinal plant was introduced into the Mussoorie

Botanical Gardens in 1883 from the Botanical Gardens, Ootacamund. This introduction was a repetition of a former attempt to establish its cultivation at that place.

"The system of cultivation followed has been to lift the crop of tubers annually late in January, or early in February when the vines have died down, immediately replanting them in new ground in well-manured rows placed four feet apart, and allowing a space of one foot from tuber to tuber. Stakes are inserted along both sides of the rows for the vines to climb upon; but these need not be placed in position until the commencement of the monsoon rains, as little growth is made from February to June. When the rains have fairly commenced, the vines begin to grow actively, but most overground, and probably underground growth is made from September to the end of November. The plants begin to flower in October, but flowers are produced in greatest abundance during November and the early part of December, and when not checked by frost, the plants continue blooming to the end of December. Seed is sometimes formed, but not more than an ounce or two of sound seed has ever been collected in a single season, so that we have had to depend entirely on the annual increase of tubers for the extension of the area under cultivation.

"As already stated, a commencement was made at Mussoorie in 1883. The original stock consisted of 300 small tubers, weighing 16 pounds. In 1885 the stock had increased to 2,150, weighing 98 pounds, and in 1887 the weight had increased to 480 pounds. Half of the crop of the last-named season was dried with the intention of sending it to the Medical Depôt, Calcutta; but that institution could only take a 10-pound sample, as previous arrangements had been made for the year's supply from Europe. The bulk of the dried tubers became mouldy, and had to be thrown away. The garden consequently began cultivation in 1888 with a stock of 240 pounds of tubers, which had increased to 640 pounds by the end of the season. In 1889 the crop was not lifted and replanted as in former seasons. It was thought that, by allowing the crop to remain undisturbed for a season, the rate of increase would be greater than under the system of lifting and replanting immediately. This idea, however, proved erroneous, for when the crop was lifted and weighed in 1890, the outturn only scaled 770 pounds—an increase of only 130 pounds, representing the growth of two seasons. Many of the tubers were in a rotting or decayed condition. In 1891 the crop was lifted as formerly, and found to have increased to 830 pounds; but in addition to many decayed tubers, many of those which were apparently sound were found, on examination, to be attacked by a disease resembling potato murrain. The crop of 1892 is not ripe enough for lifting, but I fear that, as there are many blank spaces, the disease has spread.

"In 1890 it was suggested that the plant might be tried at various altitudes in Kumaon; and the Government of the North-Western Provinces distributed a circular to tea planters and others offering a supply of tubers for trial. In response to the circular over twenty applications for tubers were received. In most cases the tubers failed to germinate, and in the few instances in which they sprouted the plants died down

after a time. I am, on the whole, inclined to believe that the North-Western Himálaya is the wrong locality in which to expect complete success; but am of opinion that the valleys beyond Darjeeling, where cinchona thrives best, will be found a suitable locality, and the experiment, if it has not already been tried, is certainly worthy of trial."

Madras.

In 1866, Mr. J. Broughton, Quinologist to the Madras Government, brought out to India from England some tubers of the jalap plant, which were planted in the gardens of the Agri.-Horticultural Society, Madras, and in the Government Botanic Gardens at Ootacamund. The tubers planted in Madras grew at first, but the plants gradually flagged and died. Those planted at Ootacamund grew with great luxuriance, and after a few months each plant produced a fine cluster of tubers. Chemical examination of sun-dried sliced tubers was made, and the amounts of resin, as compared with a good sample of commercial jalap obtained from Mr. Hanbury, were as follows:—

Indian-grown Jalap.	Commercial Jalap.
Tuber No. 1, 11·0 per cent.	11·0 per cent.
„ „ 2, 10·6 „ „	
„ „ 3, 11·2 „ „	

In a foot-note to page 443 of the *Pharmacographia*, Flückiger and Hanbury say that on the 15th January, 1870, they received from Mr. Broughton a cluster of tubers of jalap weighing 9lb. Mr. Jamieson, in his Annual Report of the Botanic Gardens and Park of the Nilgiris for 1879-80, states:—"The propagation of jalap was started in the Ootacamund Gardens in 1877. Our stock then consisted of 100 plants that had been grown in the gardens for ornament. Although the tubers increase to a large size, and the stems grow luxuriantly and flower profusely, the flowers do not fertilize freely, and produce but few seeds in the climate of Ootacamund; consequently the increase of the plant has been confined almost entirely to propagation from root and stem cuttings. This work has been carried on steadily, until there are now upwards of 25,000 plants and root cuttings permanently planted out. The tubers were at first planted four feet apart, but it was found that they did not exhaust the land, and thrive equally well when planted closer. They are, therefore, now planted in rows three feet apart, and the distance between each plant in the row does not exceed two feet, so that 25,000 plants give a total area planted of five acres. The cost of cultivation, weeding, etc., is also much reduced by close planting.

"*Method of cultivation.*—Having no data to guide me regarding the climate and soil which are natural to the jalap plant, I tried it in a variety of situations, and now find that it thrives best in a tolerably rich, dry, and friable, loamy soil; in fact, conditions of soil that are indispensable to the production of good potatoes seem equally necessary to the growth of jalap; good grass land is preferable to open rich forest land;

IMPERIAL INSTITUTE SERIES.

HAND-BOOKS

OF

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No. 19.

MICA.

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Price Two Pence.

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INDIAN MICA.

Photo^{d} by T. H. Holland. Litho^{d} & Print^{d} at Geol. Survey Office.

Exposure of Mica at Inikurti, Nellore district, Madras.

[This product is described in Dr. Watt's Dictionary of Economic Products, Vol. V, M. 509—513.]

MICA.

The account given in this hand-book, which has been prepared in collaboration with Mr. T. H. Holland, of the Geological Survey of India, is a short summary of the present state of our knowledge concerning the characters, occurrence and trade in Indian marketable micas, treated purely from an economic point of view.

I.—INTRODUCTION.

The somewhat exceptional nature of the petrological conditions necessary for the formation of large sheets of mica must always be a serious contributor to the irregularity of its production, and make a local industry of a somewhat precarious nature. Moreover, large crystals, which have been formed under the most favourable conditions, may, for industrial purposes, be rendered useless by subsequent changes; from the nature of the mineral it is extremely liable to depreciation. The transparency, for example, is sometimes wholly or partially destroyed by interlaminar inclusions or infiltrations of other mineral substances. In the Nellore District, large sheets of muscovite, otherwise devoid of flaw, are rendered almost useless on account of the included films of brown and black material in bands crossing one another at angles of 60°, like the dendritic inclusions in the Pennsbury and New Providence (Pennsylvania) muscovite, which Dana proved to be thin films of magnetite. Secondary decomposition by exposure to weathering agents impairs the transparency of the crystals; and, being one of the weakest of rock-constituents, it suffers deformation from the slightest earth-movements, and thus becomes permanently disfigured by irregular crumplings, or by fractures along the cleavage, and so-called "gliding-planes." On account of these circumstances there is always a wide, and exceedingly variable, margin of waste in mica-mining; but the percentage of rejected material is subject to such great local variations, that it is impossible to give an estimate of any value for a large country, or for any considerable length of time in a limited area.

Variable production of Mica.

The minerals included by mineralogists in the group of *Micas* are frequently known in commerce as *talc*—a name now reserved for the foliated variety of steatite, a hydrous silicate of magnesia occurring in "micaceous" laminæ and scales, which are flexible, but not elastic, as is the case with mica, and which differ from the latter mineral, also, in possess-

Confusion of the names, "Mica" and "Talc."

ing a soapy touch. This confusion between the two names seems to have extended as far back at least as the 16th century, when Agricola, in an appendix to his works (1546), speaks of *talck* and *glimmer* (the name now used in Germany for mica) in a manner which showed that they were characterised by sparkling star-like appearances as seen in scattered flakes of either mineral. The word *Talc* is said to be of Arabic or of Moorish origin, and refers either to the glittering spangles, or to the phenomenon of *asterism*, frequently displayed by micas (especially some phlogopites) when a candle-flame is viewed through a sheet of the mineral; and the frequent use of the substance for windows before the invention of glass may have facilitated the observation of this peculiar property. If this explanation be the true one, then the mineralogist, not the merchant, is for once in error in so limiting the definitions. But whoever may have been the original offender in introducing the not unnatural confusion, we shall, for the sake of convenience, employ only the more generally established name, *mica*, for the minerals described in this hand-book.

II.—MINERALOGICAL CHARACTERS OF THE MICAS.

The minerals which constitute this group, though differing considerably in chemical composition and exhibiting variations in certain physical properties, possess one common striking characteristic—a highly perfect basal cleavage, by which the crystals may be split into the thinnest films. It is to this property, and to the highly elastic nature of the lamellæ (by which mica is distinguished from the flexible, foliated, but inelastic mineral, talc), as well as to the fact that it is able to withstand high temperatures and is a bad conductor of electricity, that mica owes its commercial value; and it may be said also that the delicate nature of the mineral, consequent on its lamellated structure and perfect flexibility, is the prime cause of uncertainty in local supply.

Chemically speaking the micas may be looked upon as silicates in different proportions of alumina, the alkalies (principally potash), iron and magnesia; and according to the predominance of the different bases they may be divided into two groups,—(1) *the alumino-alkaline group* and (2) *the ferro-magnesian group*. Giving the bases in descending order of importance the two groups may be expressed as follows:—

Silicates of—

I.		II.	
Alumino-alkaline	Alumina. Alkalies. Iron. Magnesia.	Ferro-magnesian	Magnesia. Alumina. Iron. Alkalies.

The variations in physical properties accompanying changes in chemical composition, and the tendency to decomposition dependent thereon, affect the economic value of the mineral. We thus have the two varieties muscovite and phlogopite, and to a less degree, biotite, as the most valuable, whilst the remaining micas are either unsuitable in character or of too rare occurrence for commercial use. The following are the principal varieties:—

I. Alumino-alkaline group.

(*a*) *Muscovite.*—Almost pure silicate of alumina and potash, generally with small, but variable, quantities of water, and passing gradually through margarodite into the hydrous forms. Usually it is almost colourless, or with faint tints of ruby (Hazáribágh, Bengal), olive-green (Nellore, Madras), and, in exceptional cases, deeply coloured or darkened by inclusions. The

transparency also may be destroyed either by inclusions or by decomposition. Cracks are frequently found dividing the crystals into equilateral triangles, and, when the crystals are sufficiently thick, these division-planes are seen to be oblique to the lamellæ (basal plane). This feature is very noticeable in the specimens of mica from Nellore sent to the Imperial Institute.

(*b*) *Lepidolite.*—Silicate of alumina and potash, a portion of the latter being replaced by lithia, rubidia and caesia. Fluorine is also a common constituent of lepidolite. It is frequently found in association with tin-stone —a mineral which, when found *in situ*, seems always to be accompanied by fluorine-bearing species. Such an association was recognised in the Hazáribágh district by Mallet. Lepidolite usually occurs in scaly masses of a rose-red or lilac colour, and it is probable that the ruby tint of the Hazáribágh muscovite may be traceable to a similar cause.

2. Ferro-magnesian group.

(*c*) *Phlogopite.*—Essentially a silicate of magnesia with small quantities of iron, and found in association with magnesian rocks like serpentine and dolomite, as in South Mirzapore, Bengal. This mineral, though sometimes colourless, is more generally coloured brownish yellow or tinged with green. Much of the Canadian mica in the market belongs to this variety.

(*d*) *Biotite.*—This mica is characterised by the large quantities of iron in its composition, and is generally, though not necessarily, dark coloured or even black. On this account the use of biotite in the arts is greatly restricted. Much of the so-called "amber-mica" of the market belongs to this variety.

These four varieties of mica are found in India, but only muscovite, and, to a much smaller degree, biotite are exported for industrial uses. The remaining micas are either unsuitable in nature, or are too sparsely distributed for commercial purposes, and are therefore not noticed in this handbook.

III.—USES OF MICA.

The peculiar physical properties of the micas have secured for these minerals very widely extended uses in the arts—the size of the crystals, their highly perfect cleavage, their flexibility and elasticity, transparency and athermancy, chemical stability and imperfect powers of conducting electricity are properties which no other mineral can combine, and which cannot be readily or cheaply imitated by artificial means.

The earliest use of mica was probably in windows and lanterns, and for some time the material was known as Muscovy glass (*Vitrum Muscoviticum*), the name *muscovite* being restricted to a special variety by Prof. J. D. Dana in 1850. It was, however, subsequently replaced by the cheaper artificial substance, glass; but in the early stages of glass-manufacture, when the processes for annealing plates had not been devised, mica was still retained for use in places where the window would be subject to sudden shocks or violent vibrations, as, for example, in the windows of men-o'-war, where the shocks of artillery firing shattered the badly annealed glass. Since, however, the annealing of glass has been brought to such perfection it has entirely replaced mica even for this purpose. In lanterns mica has been replaced by glass and horn; but in places where there would be considerable risk attending a breakage, mica is still retained to some extent for lantern-uses.

Use in windows and lanterns.

No artificial transparent substance has, however, been devised to replace the mineral where high degrees, or sudden changes, of temperature take

place. It has, therefore, considerable use in anthracite-stoves, where it is desirable to obtain the cheerful glow of the fire without the direct heat. Its transparency is little affected by the repeated and alternate heating and cooling, and it is not readily attacked by the gases and vapours, although it does not so effectually resist the attacks of the gases from a bituminous coal, and is, moreover, so quickly blackened by the soot that it soon loses its transparency. Its use, therefore, is confined to anthracitic, or to gas-asbestos stoves.

Stoves.

Chimneys for oil and gas-lamps with round burners are sometimes made of mica, especially those outside drapers' show-windows, where glass would not stand rain-drop splashes and sudden changes of temperature, whilst a breakage would involve considerable risk from fire.

Lamp-chimneys.

In consequence of its transparency for light and its opacity for radiant heat, we find mica employed as fire-screens, in the peep-holes of furnaces, and as screens in the laboratory and workshop for observing the processes in a highly heated furnace without suffering from the intense heat.

Fire-screens.

Mica has been used for vibrating plates in the photophone, and Edison has employed it also for vibrating plates in the telephone, and as a substitute for glass in the reflectors of electric lamps. By far the largest demand of this mineral for electrical purposes obtains in America, the construction of dynamos and electric motors finding an important use for it on account of its excellent insulating properties and its elasticity; strips of various dimensions, but usually about 1 inch wide and from 4 to 8 inches long, being used. The main drawback to the use of the mineral for this purpose is its want of toughness. Perhaps one of the latest uses to which ground mica has been applied is in the manufacture of the insulators on telegraph poles.

Electrical appliances.

Probably the most extensive use of mica, at least in India, is for ornamental purposes, either in its natural state or artificially coloured. In the days of ancient Rome the powdered material was scattered over the surfaces of the amphitheatre to obtain a brilliant glistening effect. In India it is used at native festivals, marriages, and in the Mahommedan maharam for processional ornaments as lamps and tinsel decorations on banners; on fans, in temples, palaces, etc. The powder is used for ornamental pottery; on curtains and cloths; in calico-printing, and by the *dhobi* (washerman) to give a sparkle to cloth, to which the fine particles easily adhere. Coloured micas have also been suggested as a substitute for coloured glass, but its use in this direction must be limited, and as the coloured micas contain larger proportions of iron, they are more susceptible to destruction when exposed to the weather. There seems no reason, however, why the quantities of amber-coloured biotites, as well as the muscovites with inclusions of magnetic oxide in regular patterns, should not be so used in unexposed places. Natives in the Trichinopoly district of the Madras Presidency, and elsewhere, sell large numbers of pictures and portraits painted on mica-sheets of various sizes. The writer is informed by the Collector of Trichinopoly that the mica used in that district for painting pictures on, etc., is purchased by the painters from the Marakoyers (a class of Mussulmans) of Negapatam, who purchase large quantities of mica every year from ships arriving there from Calcutta and other sea-coast towns, for making the big taboots for the Kanthiri festival, and retail some to the painters. Mention may be made of the use of mica for ornamental purposes by the aborigines of America, where it has been found in the graves of ancient tribes of Indians, and in localities which would indicate a certain amount of commercial intercourse amongst widely separated tribes during, what has been called by an American writer,

Ornamental uses.

prehistoric times, although it must be understood that the local interpretation of that term does not necessarily imply anything very ancient.

The utilisation of waste mica and clippings became an important consideration in the later development of the industry. There are a few firms engaged in the grinding of mica-waste, the products being sold in different grades. Some of this is used as already indicated on wall-papers and for other decorative purposes, some is used for steam and water-valve seats; the poorer qualities are sold for mixing with fertilizers, for which purpose it is claimed to aid in the retention of moisture. In consequence of this property also it has been used as an absorbent for nitroglycerine in the manufacture of one of the forms of dynamite known as "rend-rock", or "mica-powder". The poorer grades of pulverised mica are successfully employed, when mixed with graphite or grease, as a lubricant for carriage axles.

Utilisation of Mica-waste.

The substance recently named "micanite" by its inventors seems to add another, and perhaps, successful means for utilising mica-waste. The films of mica are cemented together, and moulded to make sheets—plane or curved —, tubes, and other forms for electrical uses.

Under certain circumstances mica would be a convenient substitute for glass-plates or celluloid-films in photography, if perfectly polished and even plates could be obtained.

Finally, amongst the many uses to which this wonderful mineral has been applied, may be mentioned the use of black mica by the Hindus in medicine. According to the Sanskrit writers it is first purified by being heated and washed in milk; the plates are then separated and soaked in the juice of *Amarantus polygamus*, Linn. (*tandulia*) and *kánjika* for eight days. It is then reduced to powder by being rubbed with paddy (rice) within a thick piece of cloth; the powder passes through the interstices of the fabric and is collected for use. In this form it is called *dhánpábhraka*. It is further prepared for medicinal use by being mixed with cow's urine and exposed to a high degree of heat for a hundred times. The process is said to be sometimes repeated one thousand times. When this is the case, the preparation is called *sahasra putita abhra*, and is sold for as much as R8 per *tola*. Mica thus prepared is a powder of a brick-dust colour, and saline, earthy taste. It is considered tonic and aphrodisiac, and is used in combination with iron in anæmia, jaundice, chronic diarrhœa and dysentery, chronic fever, enlarged spleen, urinary diseases, etc. Its efficacy is said to be increased by combination with iron. Dose:—grains six to twelve (U. C. Dutt, *Mat. Med. of Hindus*). Ainslie states that the Vytians consider mica to have virtue in pulmonic affections, and a dark sort to be of value in flux cases. He further mentions that the Chinese imagine it to have the power of prolonging life. Although the effects obtained or imagined to be obtained, in these cases are more probably due to the substances administered with the mica, it certainly possesses one property which cannot be claimed for all medicines—it is perfectly inert and harmless.

Used by Hindus in medicine.

BYE-PRODUCTS.—Mica is invariably associated with felspar-crystals, and these have very frequently undergone considerable decomposition by the action of percolating atmospheric waters with the result that kaolin—often very pure—is produced and may be washed out for use in pottery manufacture; and, in fact, in America the Indians in the 17th century carried this mineral from the mountains of North-West Carolina to the sea-board for exportation. It has been proposed to utilize the large quantities of potash in the felspars sometimes associated with the mica for the manufacture of potash salts; but this is not likely to be practised in India or indeed anywhere whilst the wonderful beds of soluble salts at Stassfurt last.

Bye-products of Mica-mining.

IV.—GEOLOGICAL AND GEOGRAPHICAL DISTRIBUTION OF INDIAN MICA.

(*a*) Geological Occurrence.

Mica occurs in small plates in many of the crystalline and metamorphic rocks of India; but the large crystals of commercial value occur associated with felspar and quartz forming an excessively coarse-grained granite, or pegmatite, and frequently intruded into older granites, or into metamorphic rocks. The felspar, which is often orthoclase, but sometimes oligoclase, occurs in large crystals several inches or even feet in length, whilst the quartz, which was the last formed mineral in the group, occurs in large crystalline masses, but without crystalline outlines: it was moulded around the pre-existing mica- and felspar-crystals, and frequently we find striated surfaces in the shafts, which are in reality the casts in quartz of mica-bundles. That these intrusions have been affected by subsequent earth-movements seems undoubted, since the mica-sheets are so frequently crumpled; but at the same time it does not seem likely that these movements could have been of very great magnitude, otherwise the delicate sheets of mica would have been still more distorted; neither the very flexible mica nor the friable felspar could resist any serious earth-movement.

The conditions which favoured the production of large mica-, felspar-, and quartz-crystals seem to have been favourable also for the production of large individuals of other minerals, as, for example, tourmaline in Hazáribágh (Bengal), apatite and garnets in Nellore (Madras), and beryl in North Carolina (America).

(*b*) Geographical Distribution.

Bengal.—The districts of Hazáribágh, Gaya and Monghyr produce an excellent mica, which, according to Mallet, is found associated with tourmaline as a constituent of a very coarse-grained pegmatite occurring in dykes penetrating the sub-metamorphic and metamorphic rocks. The association of lepidolite, tourmaline, tinstone and apatite, which is so frequent in other parts of the world, obtains also in this area; and the muscovite may, as before suggested, have derived its ruby tint from similar causes, and will probably be found to contain small quantities of fluorine. Mr. Mallet has collected in this district plates of biotite measuring several inches across. Phlogopite occurs associated with dolomite and serpentine in South Mirzapore, whilst a beautiful green chrome-bearing mica, euphyllite, is associated in this district with corundum.

From a list kindly supplied by the Deputy Commissioner of Hazáribágh, it seems there are about 240 mines in that district with an aggregate annual rental of R14,984. It is difficult to form an estimate of the number of hands employed in these mines as they vary according to the season of the year, many of the mines being stopped during the rainy months, and the coolies are then occupied with other pursuits.

The Collector of Monghyr informed the writer that there are only three mines in the Monghyr district. These are under European agency, but two of them are reported to be closed for the present.

There are two mines in the Gaya district, *viz.*, Singar and Sapahi, both under European agency.

Central Provinces, Balaghat District.—In this district, at Chitadongri and Bamni, near Baihar, mica occurs in plates of 2 by 3 or 4 inches; these are too small to be of much value.

There are still old workings to be seen in the Baihar sub-division of this district.

"During the three working months, about four hundred maunds or fourteen tons of mica, yielding upon calculation 20,000,000 transparent plates of mica, each plate being about nine inches square, are conveyed away to Patna upon pad bullocks, the whole being valued at ₹4,000 (£400). To obtain larger plates than are generally exported, does not seem to be an object with the agents, who by their constantly urging the miners to wrench out the mica from its matrix, whether in large or small pieces, cause about three times the amount of mica actually carried away to be destroyed in the mines. The head Bandháti assured me that were time allowed him, he could produce plates of almost any size.

"The largest plates are dug from the Deilwar mine where the miners have hit upon a seam of mica, running along the base of one of the small hillocks; it is thus worked in the open air only a few feet from the level of the country; this seam, however, will be soon lost as the half wild miners have no idea of propping the roof of a mine, which must very soon fall in by its own weight." *

In describing the mines of North Hazáribágh in 1873, Mr. Mallet gave an account of the sampling of the mica into different grades and qualities as follows :—

"The plates of mica are generally brought to the miners' village, and there, after being slightly trimmed with grass-cutting knives (which are not particularly adapted to the purpose, but are probably the only ones the people are able to purchase), they are sorted into different heaps according to quality and size. The quality depends on the mineral being in a perfectly unaltered condition, its transparency and freedom from cloudiness caused by internal foreign matter, the absence of minor cleavages which render it liable to split into ribbons and triangles, and the planeness of its fissile surfaces. Six kinds are recognised according to the size of the plates, *viz.*:—

1st, *Sanjhla.*	4th, *Karra.*
2nd, *Manjhla.*	5th, *Urtha.*
3rd, *Rási.*	6th, *Admalla.*

"Some of the miners intercalate *failurtha* between *urtha* and *admalla*, and speak of another size, *barka*, still larger than *admalla*. All these terms are used rather vaguely in respect to the absolute size of the plates indicated thereby. At Dháb and Jamtára I induced the miners to separate a quantity of the mica into the different grades, and measured an average specimen of each, with the following results :—

	Dháb.	Jamtára.
Sanjhla	3″ × 4″	4″ × 3″
Manjhla	7 × 5	5 × 4
Rási	9 × 6	6 × 5
Karra	12 × 9	8 × 6

"The above four sizes include the greater portion of the mica found, it being only in the best mines that *urtha* and *admalla* are procurable.

"The mica is sold by the load, which is built up of plates either into one frustrum of a cone and carried on the head, after being bound together with cord, or into two such, and carried in a *bánghi*. A load equals 6 *paserís*, one *paserí* being equal to 5 *kacha seers* of 12 *chatáks* each, or to 3¾ *paka seers* of 16 *chatáks*; the load, therefore, being 22½ *seers paka*, or 46lb

* *Journ. As. Soc. Beng.*, Vol. XX (1851), pp. 296-298.

avoirdupois. The miners informed me the prices paid them by the *mahájan* were as follows :—

	Per load.
Sanjhla	3 annas
Manjhla	5 „
Rási	7 „
Karra	12 „
Urtha	2 to 6 rupees
Admalla	4 to 9 „

the selling prices being about double the above."*

Dressing Mica.

Under the present system of working, the blocks of mica raised from the mine are cleaned of all extraneous matter, such as quartz and felspar, in the stripping room, and when split, either for convenience of size or for the removal of material included along the cleavage-planes, the sheets are sent to be "scribed", and afterwards cut with a pair of shears into rectangular shapes along the scribing. Sheets, tin, zinc, or iron, are used as patterns in scribing; and the natives after a little training become quite expert in selecting the size and shape of pattern which will give the maximum area of clear mica in the rough sheet.

Yield of marketable Mica.

The yield of marketable mica will naturally be very variable. In the Inikúrti mine of the Nellore district Mr. Sargent sent to the market 23 per cent. of the rough block mica raised from the mine. In the American mines 10 to 12 per cent. seems to be the average yield, whilst 5 per cent. is considered inferior and 33 per cent. exceptionally high. In one case, however, as much as 75 per cent. of marketable mica was turned out.

Prices of different qualities.

Large quantities of ruby-coloured muscovite are still exported from Bengal to England and America, the former being the principal market for the rest of Europe. The prices of this mica range from R8 to R400 per maund of 80lb; and according to the late Mr. E. T. Hollingsworth, who exported large quantities from Calcutta, the average price of rectangular pieces may be set at R20 per square inch per maund. Thus plates 6″×6″ of best quality would bring 36×20, or R720 per maund, or 11*s.* 3*d.* per pound at 1-3 exchange. I find from data kindly supplied me by Mr. Sargent, who has worked the Nellore mines so successfully, that as much as 14 or 15 shillings a pound has been obtained for large plates, whilst plates 2½ inches square will bring only a few pence per pound, and up to 20 square inches at least long rectangles brought better prices on the average than squares of the same area. The demand for lower grades is at present somewhat dull owing to the quantities of small plates which have been turned out of the Canadian mines. The American prices are stated to vary from 5*d.* to 24*s.* a pound and averaging about 7*s.* Whilst the price increases in such rapid ratio with the area of the plates for the smaller sizes, the ratio does not seem to be preserved for plates larger than about 6″×8″ owing to the few uses to which very large plates of mica are put. Some very large plates have, however, been turned out of the Indian mines. In a recent consignment of ruby-coloured mica from Calcutta there were sheets measuring 9×32½, 10×29½, 11½×27 and 12×23½ inches respectively.

Very different rentals are paid for the mines. In the Hazáribágh district they vary from R8 to R1,000, but probably average about R200 to R300.

* *Records, Geol. Surv. Ind., Vol. VII (1873), p. 42.*

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